# Fuel Cells: How They'll Power Your Car

# POPULAR ELECTRONICS

SEPTEMBER 1964

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## Transmitting On ULTRASONICS

(see page 41)

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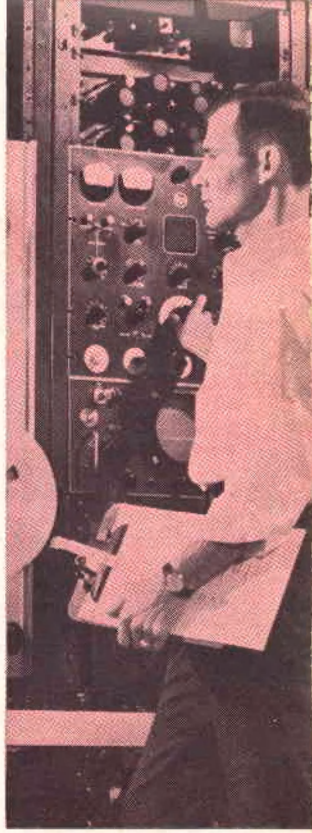

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This month's cover photo by Bruce Pendleton

VOLUME 21 SEPTEMBER, 1964 NUMBER 3


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**POPULAR ELECTRONICS** is published monthly by Ziff-Davis Publishing Company at 434 South Wabash Avenue, Chicago, Illinois 60605. September, 1964, Volume 21, Number 3. (Ziff-Davis also publishes Popular Photography, Electronics World, HiFi/Stereo Review, Popular Boating, Car and Driver, Flying, Modern Bride, Amazing, and Fantastic.) Subscription Rates: One year United States and possessions, $4.00; Canada and Pan American Union Countries, $4.50; all other foreign countries, $5.00. Second Class postage paid at Chicago, Illinois, and at additional mailing offices. Authorized as second class mail by the Post Office Department, Ottawa, Canada, and for payment of postage in cash.

PAYMENT MAY ALSO BE REMITTED in the following foreign currencies for a one-year subscription: Australian pounds (2/6/10); Belgian francs (260); Danish kroner (36); English pounds (1/17/6); French francs (26); Dutch guilders (19); Indian rupees (26); Italian lire (3300); Japanese yen (1750); Norwegian kroner (38); Philippine pesos (21); South African rands (3.80); Swedish kronor (28); Swiss francs (23); or West German marks (21).

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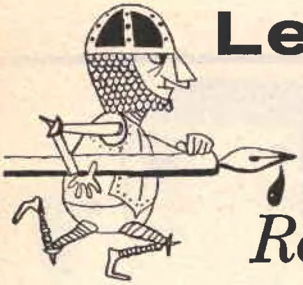

# Letters from our Readers

*Address correspondence for this department to:*
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## Designing Tunable Oscillators for CB

■ The little CB VFO tuner described in "Tune Away Rock-Bound CB Receiver" (April, 1964) should be very useful for the CB enthusiast with a crystal-only receiver, but I believe the author is too tolerant of the drift problem. Without resorting to voltage regulators or other expense-increasing devices, I have found the following circuit features to be of value in building stable VFO's. The coil should be shunted by a high-quality silver mica capacitor of at least 100 pf. *and* a small amount of negative temperature compensation—about 3.3 pf. (N750). The tuning capacitor is very important—it should be about 1-8 pf., with two small, heavy plates, of sturdy construction, and firmly bolted to the chassis; I have had good luck with a Hammarlund HF-15 with three of its five plates removed, leaving one rotor and one stator. The coil with this setup can be eight turns of #18 enameled on a ¼" slug-tuned form of the best quality. The ground end should be soldered to the chassis with a heavy-duty iron. Instability due to the use of a flexible cable to couple the VFO to the receiver might be eliminated by employing a cathode follower to transfer the oscillator signal: this could be done by changing the 6C4 to a twin triode, such as the 12AU7, and adding perhaps two small resistors and a coupling capacitor.

ALDEN FOWLER, 18A4051, WA9KHM
Greensburg, Ind.

*Thanks for the ideas, Alden. The original project was intended to stress simplicity in construction and design, but readers who want a more stable unit would do well to experiment along the lines suggested.*

## "Bathtub" Bathtub Capacitors?

■ The output of "Big TC" (July, 1964) can be greatly increased by simply emersing the glass-plate capacitors in linseed or capacitor oil. Nikola Tesla often used oil to prevent corona discharge between the primary and secondary, as well as around the capacitors.

TOM HENDRICKS
Lincoln, Neb.

*Sounds good in theory, Tom, but a bank of foot-and-a-half-square capacitors would take quite a bit of oil —and a rather large bathtub!*

## Transformers for "Big TC"

■ A good source for neon sign transformers such as that used in "Big TC" (July, 1964) is any large demolition project in a business district—for a new highway or for urban renewal, for example. After

# Letters

(*Continued from page 6*)

spending an hour looking around one such project, I found two transformers in the office of a wrecking company. After buying one and cleaning it and painting it with black metal enamel, it not only looks nice but works well, too. The price? One dollar!

SCOTT STRODTMAN, WPE8ETO
Grand Rapids, Mich.

## Modulated Tesla Coil

■ "Li'l TC" (July, 1964) brought to mind an experiment I once performed with a similar setup. Here's how it goes. You connect the primary of an audio output transformer in series with the B-plus so that audio fed into the secondary will modulate the oscillator (*V2* in "Li'l TC"). Attach a piece of stiff wire to the chassis and bring the free end up near the needle to form a spark gap. With no audio being applied, adjust for a quiet, stable arc. Then feed audio to the transformer, and you should hear the program with the sound coming from the arc. The effect can be quite striking, especially if you have an audience. To show that there are no hidden speakers, blow into the arc—keeping your nose at a safe distance!

THOMAS G. DIGBY
Pomona, Calif.

## It Sounds Fishy

■ I built your fish caller ("CQ Fish," June, 1964) and it was a howling success. The only trouble I had was in the testing. It took me five minutes to adjust

the frequency, and by that time I had a whole basement full of fish. Not only that, but I took it to work and got a bunch of Illinois Suckers.

TOM RUDIN
New Lenox, Ill.

*What'd we tell you?*

## Fact or Fiction

■ I recently came across "Flip Flap" by Sinclair (December, 1962) and enjoyed the story very much. Unfortunately, I have seen nothing like it since. How about some more light fiction?

PETER LUCAS
Ashley, Pa.

*Coming up, Pete. See next month's issue for an especially timely little piece. The subjects? A presidential election and an out-of-whack computer . . .*

## TV Cheater Cord/Filament Checker

■ After studying the article on the "Cheater Cord De Luxe" (October, 1963), I decided to incorporate a filament checker and create a really useful gadget

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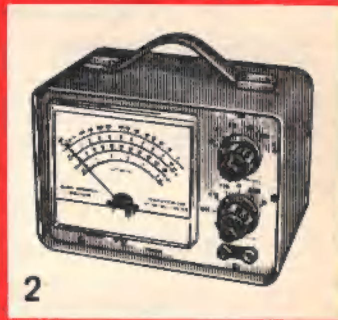

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# Letters

(*Continued from page 8*)

for trouble-shooting when crawling around in back of my TV set. The gizmo is mounted in a Budco 3" x 4" x 5" box with a red lamp for the cheater cord, an amber lamp for the filament checker, and two 150,000-ohm dropping resistors. Mounted on the front panel are sockets for 7- and 9-pin miniature tubes, an octal socket, and a socket for picture tubes.

CHARLES R. GOENS
Dayton, Ohio

## SWR Article Lauded

■ I was very impressed with "Standing Waves: Do They?" in the June, 1964, issue. There was more intelligent, assimilable information in two paragraphs than many authors put in a book. Most electronic magazines are written slightly over the average hobbyist's head, but POPULAR ELECTRONICS is written right down where we live.

CLYDE STANFIELD, WA6HEG
Upland, Calif.

*Thank you for the compliment, Clyde. We hope to continue to give you and other P.E. readers more articles on advanced electronics—written so those without extensive backgrounds can understand the subject.*

## In Defense of the Galena Crystal

■ After reading with pleasure "Restoreth Thy Relic Radio" (May, 1964), Mr. Garner's very well done piece in the same issue—"The Fabulous Diodes"—was nearly spoiled for me by his opening attack on the old-time galena crystal which he terms "unreliable, finicky, open-air, and ugly . . ." The galena crystal, once a sensitive spot was found, performed indefinitely. I have some galena crystals in my possession that are over 50 years old and they're till "reliable." In answer to the charge of "finicky," I would point out that the long time spent in selecting one of a good crystal's hundreds of sensitive spots usually fell in the same category as "knob twiddling"—the finicky part of the galena-DX'er combo was always the DX'er. Sure, galena crystals were "open-air" devices, but at least they could be adjusted. I challenge Mr. G. to


do this with one of the new-fangled sealed-up types. To the old-timer, the allegation that galena crystals were "ugly" is the most heartless of all. Really "seeing" a galena crystal comes with the original thrill of hearing. One can only "see" the beautiful (and miraculous) galena crystal after gazing at one for hours, phones glued to the ears, cramps in the legs and elbows,

# Letters

*(Continued from page* 10)

and then hearing, like a voice from another planet, "Hello, this is radiophone broadcasting station . . ."

Ed Newman, Chief Engineer, WDBJ-TV
Roanoke, Va.

## Relay Ignition Switching

■ With reference to "Relay Switching for Transistor Ignitions" (May, 1964), some car owners may have difficulty if an "idiot light" is used as a battery charge indicator. If there is a return circuit through the lamp and relay coil, the relay will not release, even when the ignition is turned off, and the engine will continue to run. To correct this condition, you can connect a 500-ma., 400-PIV silicon diode in series with the "hot" lead of the idiot light. This lead is usually connected to one of the voltage regulator terminals; the cathode of the diode is connected to the voltage regulator and the lead to the anode of the diode. Incidentally, a very reasonably priced relay which can be used for ignition switching—a headlight relay—is available at auto parts dealers everywhere, and sells for 98 cents to $2.50.

Boghos N. Saatjian
Los Angeles, Calif.

## Salt Spray Dampens TV

■ I live in a coastal area and have a bad problem as a result of salt spray. The area is in a deep TV fringe area, and unless I waltz a water hose around the roof once a week, there is a severe attenuation of signals

from the accumulation of dirt and salt deposits. If any P.E. readers have found a *foolproof* solution to this problem, I'd like to hear from them.

Mike Davis, WPE4BTX
1810 South Ocean Blvd.
Myrtle Beach, S.C.

## Low-Frequency Hi-Fi

■ When buying a hi-fi system, it is generally conceded that one should, among other things, get a speaker with as wide a frequency range as possible. Considering that 60 cycles per second is the nadir for existing musical instruments, however, what difference does it make whether or not the speaker has good response below this frequency?

Phillip Lombard
Rochester, N.Y.

*The only trouble, Phil, is that a bass tuba can hit 43 cycles, and an organ 16. Also, we think you'll find that greater "presence" can be obtained with a system that has good bass response, the frequency of the musical instruments notwithstanding.* —30—

# Tips and Techniques

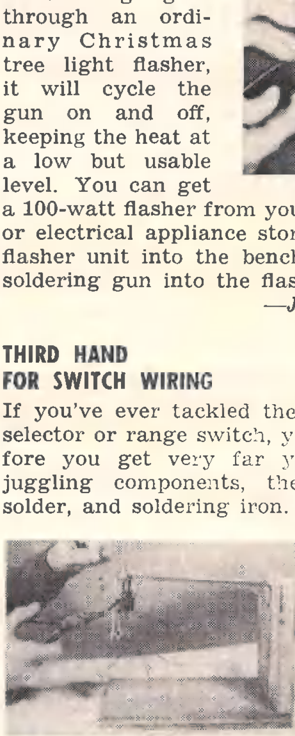
## LIGHT FLASHER MAKES LOW-HEAT SOLDERING GUN

Ever need a particularly low heat for soldering miniature or transistor circuits? If you connect your soldering gun through an ordinary Christmas tree light flasher, it will cycle the gun on and off, keeping the heat at a low but usable level. You can get a 100-watt flasher from your local hardware or electrical appliance store. Just plug the flasher unit into the bench outlet, and the soldering gun into the flasher.

*—John Lias Wilson*

## THIRD HAND FOR SWITCH WIRING

If you've ever tackled the job of wiring a selector or range switch, you know that before you get very far you find yourself juggling components, the switch, wires, solder, and soldering iron. To make switch wiring much easier, you can build a temporary switch mount from two 6"-wide boards and an ordinary shelf bracket. Attach the boards and bracket as shown in the photo. You'll have to enlarge the screw hole in the end of the bracket to 3/8" to take the switch shaft. Use a control nut to hold the switch being worked on, and simply loosen the nut when you want to rotate the switch.



*—Rus Arnold*

## "LEAD WOOL" INERTIA TUNING

In an effort to save space and cut down cost, most manufacturers of small shortwave receivers eliminate the inertia tuning

(*Continued on page* 22)

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- Variable AFC Control
- Imported

# NEW! LAFAYETTE Criterion• 1000-PROFESSIONAL 4-TRACK SELF-CONTAINED STEREO TAPE RECORDER

featuring **MAGNIFICENT TEAK CABINETRY**

- Plays 2- and 4-Track Stereo and 4-Track Monaural
- Records 4-Track Stereo and Monaural
- 3-Speeds: 1⅞, 3¾ and 7½ ips
- 6 Pushbutton Tape Motion Controls
- Records Sound with Sound
- Automatic Shut-off Electrically and Mechanically Returns Recorder to Stop Position
- Transistorized Stereo Preamplifiers
- Complete with 2 Dynamic Microphones, Cables, 7" Take-up Reel
- Imported

99-1501WX 199.50

# NEW! LAFAYETTE 23-CHANNEL CRYSTAL-CONTROLLED DUAL CONVERSION 5-WATT CB TRANSCEIVER

## WITH ADVANCED "RANGE-BOOST" CIRCUIT

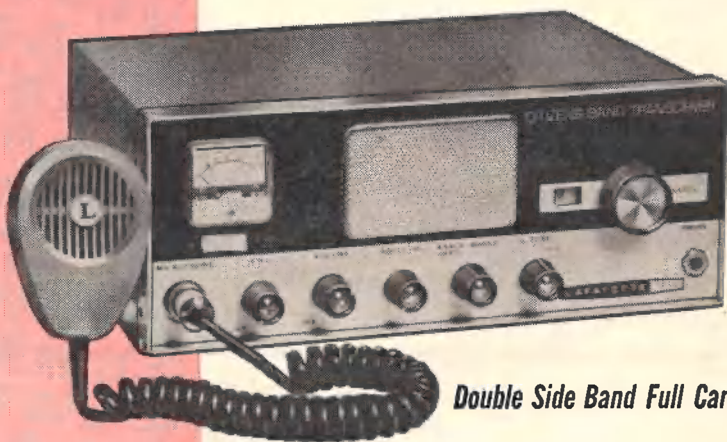
## Model HB-400

Efficient, dependable 2-way communications in any fixed or mobile application is assured with this rugged, new 5-watt CB transceiver. A military-type frequency synthesizing circuit makes it possible to transmit and receive over the full range of 23 channels with crystal-controlled accuracy—no extra crystals to buy and install! Advanced Range-Boost circuit can be used to increase sideband power during transmission—lets you get through when noisy conditions make reception of your signal difficult!

Highly efficient circuit design uses 13 tubes (including two nuvistors) and 8 diodes to provide top performance under a wide range of operating conditions. Dual-conversion receiver offers high .3 μv sensitivity and low noise, plus excellent adjacent channel rejection. Includes every needed feature for optimum reception—crystal-controlled "fine tuning" capability on all channels of ±2.5 Kc (Delta Tuning), high-efficiency variable noise limiter, variable squelch, and Automatic Volume Control. Also included is an illuminated meter which indicates relative RF power output or received signal strength in "S" units, and plug-in facilities for the Lafayette PRIVA-COM selector call unit.

Operates in a fixed or mobile location with equal ease . . . has built-in power supply for either 117V AC or 12V DC. Specially designed "Vari-Tilt" mounting bracket simplifies mobile installation—permits fast removal of the transceiver too! And, there's nothing else to buy—you get all crystals and a built-in vibrator for 12V DC, plus 2 power cables. Measures a compact 12"Wx5"Hx10"D (including controls and plugs at rear). Imported. Model HB-400.

**99-3001WX** **169$^{50}$**



*Double Side Band Full Carrier*

- Meets All FCC Requirements
- Precision-Engineered and Ruggedly Built For Reliable 2-Way Radio Communications

■ Frequency Synthesized Circuit Provides 23 Crystal-Controlled Transmit & Receive Channels—No Extra Crystals to Buy! ■ Continuous One-Control Channel Tuning ■ Full 5-Watt Input ■ Push-To-Talk Microphone & Electronic Switching ■ Dual Conversion Receiver With 3/10 μv Sensitivity ■ Delta Tuning Offers "Fine Tuning" of ±2.5Kc on Receive ■ Variable Squelch, Variable Noise Limiter, AGC ■ Built-in 117V AC & 12V DC Power Supply ■ "Vari-Tilt" Mounting Bracket for Easy Mobile Installation ■ Plug-in Facilities For Lafayette Selective Call Unit

## ADVANCED "RANGE-BOOST" CIRCUIT

*Increases Your Effective Range—Lets You Get Through When Others Fail!*

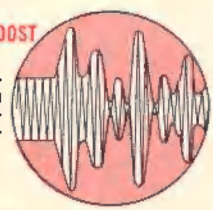
Want to effectively increase your range? You can—with Range-Boost! A simple turn of a switch on the HB-400 increases the average percentage of modulation and lets your voice cut through QRM and noise to reach further . . . gives you more "talk-power" when you need it—without overmodulating!

**CONVENTIONAL**

**Average Percentage of Modulation Is Lower**

**WITH RANGE-BOOST**

**Average Percentage of Modulation is Higher—Sideband Power is Increased**



# NEW! LAFAYETTE ALL-TRANSISTOR DUAL CONVERSION 5 WATT CB TRANSCEIVER

## FEATURING AUTHENTIC MECHANICAL FILTER

## Model HB-500


Small, Compact . . . Measures Only $11\frac{7}{16}$"W x $6\frac{11}{16}$"D x 3"H.
Low Current Drain . . . 350 ma on Receive, 850 ma on Transmit.

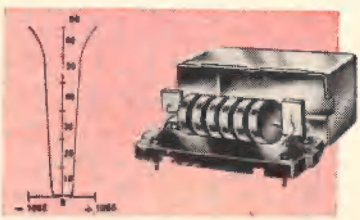
*■ 12 Crystal Transmit Positions plus 12 Crystal Receive Positions ■ 23 Channel Tunable Receiver with Precise Vernier Tuning ■ Dual Conversion Super-heterodyne Receiver ■ 15 Transistors, 3 Diodes, 1 Zener Diode plus 1 Thermistor ■ Zener Diode Voltage Regulated Receive Oscillator for Superior Frequency Stability ■ Dependable Sealed Relay Switching ■ Automatic Noise Limiter ■ Variable Squelch ■ For 12 Volt DC Mobile Operation (Negative or Positive Ground) or for 117V AC Operation when used with Matching Solid State AC Power Supply (Optional) ■ Meets All FCC Regulations Part 95*

If you're looking for a high-performance CB transceiver in a small, compact size, you'll want the HB-500! Using advanced solid-state circuitry, this transceiver offers full 5-watt performance, yet is small enough to fit conveniently into the most compact car. And, battery drain is so low as to be negligible—the transceiver draws no more than .35 amps on receive, .85 amps on transmit. As a result, you need neither heavy-duty battery nor generator—an important advantage in mobile applications! The transmitter features full crystal control on any 12 of the 23 CB channels. Dual conversion receiver with better than .5 µv sensitivity offers 12 crystal-controlled channels, plus full 23 channel tuning capability. A 455 Kc mechanical filter provides ultra-sharp receiver selectivity—virtually eliminates adjacent channel interference! Other features include an efficient Automatic Noise Limiter, variable Squelch for silencing the receiver on standby, spotting switch for exact frequency location on tunable receiver, "S" meter and illuminated channel dials. This rugged transceiver offers instantaneous, cool-running operation and features printed circuit, all-transistor design. Equipped with mobile mounting bracket, push-to-talk dynamic microphone, crystals for operation on channel 12. Operates on 12V DC (neg. or pos. ground) or on 117V AC with optional solid-state power supply. Imported.

Model HB-500.

**139$^{50}$** 99-3027WX

## HIGHLY SELECTIVE MECHANICAL FILTER



**With CB channels only 10 Kc apart, selectivity is important! In the HB-500, ultra-sharp selectivity is achieved by means of a true mechanical bandpass filter in the 455 Kc IF section. At 10 Kc on either side of the center frequency, the filter provides 60 db of attenuation — an extremely high rejection ratio that assures complete adjacent channel rejection!**

### Model HB-501 Solid State AC Power Supply

Matching solid state AC power supply for HB-500 for fixed station operation (at home, business office). Transceiver rests on power supply to form attractive integrated unit. Size $11\frac{7}{16}$x$6\frac{11}{16}$x$3\frac{11}{32}$". Imported.

**99-3028** ........................ Net **16.95**

CIRCLE NO. 20 ON READER SERVICE PAGE

# Tips

*(Continued from page 14)*

feature which permits you to spin the dial from one end of the band to the other. You can provide inertia tuning yourself with a material known as "lead wool." Available from plumbing supply houses and some hardware stores, it consists of heavy, "dead-soft" lead fibers. Just remove the main tuning dial of your receiver, and tamp the back of the dial full of lead wool. The added weight does the trick.

*—Bob Kuehn, WØHKF*

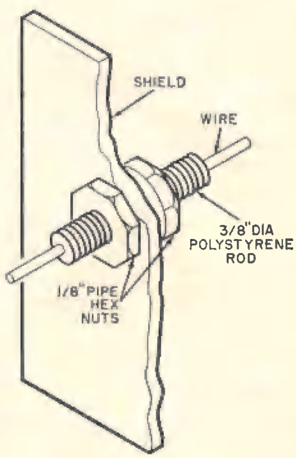
## PLASTIC DYES FOR COLOR-CODING

While milady's nail lacquer is an ideal medium for color-coding, it has one drawback—it only comes in varying shades of red. True, recent fashion trends also provide shades of green or blue as well as silver, but if you purchase clear nail polish, you can tint it to any color you wish simply by adding one or more of the dyes used to color liquid plastic casting mixes. These dyes are carried by most hobby shops, and they mix well with all makes of colorless nail polish.

*—Margie V. Erickson*

## MAKE YOUR OWN FEEDTHROUGH BUSHINGS

Feedthrough bushings that come in handy when building VHF receivers, transmitters, and experimental equipment can be easily made for a few cents each. Lock a ⅛" pipe hex nut in a vise, and chamfer the the end of a ⅜" polystyrene rod. Thread the rod by screwing it into the nut, making sure to get the thread started right. Cut the threaded rod into ¾" lengths and drill through it with a $\frac{1}{16}$"- to ⅛"-diameter drill. Then mount the bushing with a nut on each side of the shield, and simply thread your wire through it. That's all there is to it.



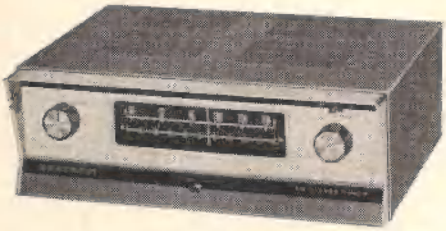

*—Wilfred E. Beaver*

# New Products

*Additional information on products covered in this section is available from the manufacturers. Each new product is identified by a code number. To obtain further details on any of them, simply fill in and mail the coupon which appears on page 15.*

### FM STEREO TUNER KIT

A low-cost ($49.95) FM stereo tuner kit has been announced by the *Heath Company.* There are only three simple-to-use controls on the Model AJ-13: an automatic frequency/on-off switch, an on-off FM-stereo selector, and a flywheel tuning control. The 7-tube-envelope circuit has 12 tube functions which include FM multiplex reception. Sensitivity is $2\frac{1}{2}$ $\mu$v. for 20 db of quieting;



Circle No. 75 on Reader Service Page 15

mono frequency response, $\pm1$ db from 30 to 20,000 cycles; stereo response, $\pm2$ db from 50 to 15,000 cycles. Harmonic distortion is 1% or less at 1 kc., channel separation 25 db or more. Features include a stereo broadcast indicator light and a large edge-lighted slide-rule dial. A matching 16-watt amplifier (the AA-32) is available for $39.95.

### SPECIAL-PURPOSE RECEIVER

Developed by *Regency Electronics, Inc.,* the Model TM "On-Call" Monitoradio is specifically designed to alert off-duty or volunteer firemen or policemen, emergency squads, or private ambulance crews. The 18-transistor, 7-diode unit (with all options) boasts 1-$\mu$v. sensitivity, and a three-way power supply which can be operated from house current, a car battery, or with an optional battery pack using nickel-cadmium rechargeable batteries. An emergency tone alert is also incorporated on an optional basis. Four basic models of the "On-Call" Monitoradio are available: single-channel crystal or multichannel with up to six crystals, covering either 150 to 175 mc. or 30 to 50 mc. Units for special frequencies are available on request. Prices start at $99.95.

Circle No. 76 on Reader Service Page 15

### PACKAGE DEAL FOR WOULD-BE HAMS

*Conar Instruments'* complete Novice "package" consists of a three-band (80, 40, and 15 meters) receiver, a 25-watt transmitter, a key, and an ARRL manual to help the potential amateur operator earn his license. Capable of picking up AM, c.w., and SSB transmissions, the receiver features vernier

Circle No. 77 on Reader Service Page 15

tuning, two i.f. stages, two audio stages, transformer-operated power supply, built-in speaker, separate BFO, antenna trimmer, variable i.f. gain, and headphone jack. The transmitter is crystal-controlled and includes a pi-network output and a 3" panel meter. Both units are easy to construct. Price of package, $64.00. The receiver is available separately for $37.50, the transmitter for $32.50.

### CARDIOID DYNAMIC MICROPHONE

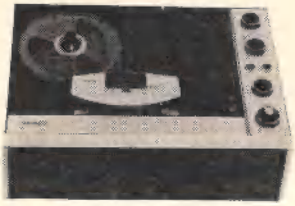
Specifically designed for the home recordist, *LTV University's* new Model 8000 is a shock-mounted cardioid dynamic microphone. The cartridge produces a smooth frequency response from 70 to 15,000 cycles, and the diaphragm will, under normal operating conditions, retain its original level of performance throughout the life of the microphone. Under a special warranty, the Model 8000 is guaranteed against all defects in material and workmanship for five years. Price, $29.95.

Circle No. 78 on Reader Service Page 15

### STEREO TAPE RECORDERS

Two broad new lines of stereo tape recorders have been introduced by *Ampex Corporation:* the "2000" series and the "1000" series. The "2000" line incorporates a self-

reversing mechanism and automatic threading. The "1000" line has the same basic design and performance without the automatic features. Each line consists of three recorders (plus separate speakers and microphones): a completely self-contained portable unit; a furniture model tape deck in oiled walnut cabinet; and an unmounted tape deck for component systems. The latter "2000" series model is shown in the photo. All models in both lines operate at 7½, 3¾ and 1⅞ ips, record 4-track stereo or mono, and play back 4-track stereo or mono and half-track mono or full-track mono. Prices start at $350.00.



Circle No. 79 on Reader Service Page 15

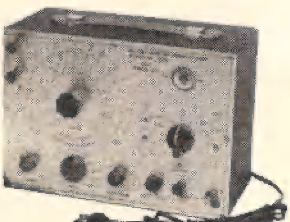
## DRY TRANSFER CIRCUIT SHEETS

To simplify the preparation of etched circuit boards, *Prestype, Inc.* has introduced 16 separate Etch-Tronics sheets. Each 12" x 16" sheet carries one specific part of a circuit, repeated many times. After you chemically clean a laminate board, you burnish an Etch-Tronics circuit directly on the board using a burnisher, ball-point pen, or even a paper clip. Then chemically clean the board again—carbon tet is recommended—etch it, clean it once more, and it's ready for use.

Circle No. 80 on Reader Service Page 15

## COMBINATION RC BRIDGE/CAPACITOR CHECKER

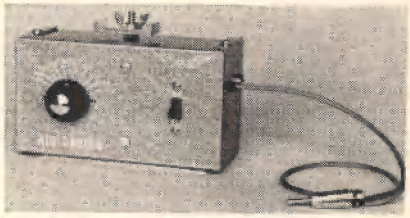
An unusual combination of functions are featured in the *Electronic Measurements* Model 801 resistance-capacitance comparator bridge and in-circuit capacitor checker. In-circuit tests that can be made include detection of open capacitors for any value above 50 pf., with shunt resistance as low as 30 ohms for 350 pf.; short detection on all non-electrolytic capacitors, with shunt resistance as low as 100 ohms; and indication of intermittents. Out-of-circuit functions include bridge resistance measurements from 0.5 ohm to 500 megohms in four ranges; capacitance from 10 pf. to 5000 $\mu$f. in four ranges; leakage at rated voltage up to 500 volts; and power factor from 0 to 60%. Prices: $24.95 (as a kit); $38.95 (wired and tested).



Circle No. 81 on Reader Service Page 15

## "AIR-DAPTER" CONVERTER

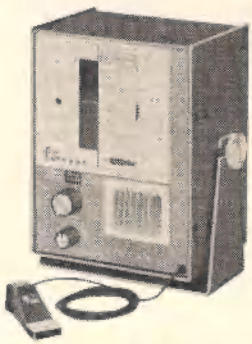
Want to make your car radio a VHF receiver and listen to aircraft towers, arrivals and departures, and other airport transmissions? The *Livingston* "AIR-DAPTER" is a transistorized VHF converter, with self-contained battery supply, that provides reception of the aviation signals in the 108-126 mc. range. The auto receiver, which acts as an i.f. when used with the converter, is simply tuned to 1000 kc. No further adjustment is necessary, and all other tuning is done with the converter. The internal 9-volt battery will last many hours and can be replaced by removing the four cover screws. Price, $21.95.



Circle No. 82 on Reader Service Page 15

## DARKROOM ENLARGING AID

Determining the proper printing paper contrast and exposure time is easy with the Mitchell Fotoval® Computer System. Introduced by the *Heath Company*, the Fotoval was invented by photography enthusiast Robert Mitchell and engineered by Heath in conjunction with Weston Instrument & Electronics. The light-sensitive probe allows measurement of desired highlight and shadow areas smaller than the hole in an IBM card. And anyone, regardless of experience, can develop the prints the darkroom worker has made—or the undeveloped prints can be stored in a light-tight box and developed later. Available in kit form from Heath, the Fotoval can also be purchased wired from any Weston photo dealer. —30—



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# BREAKTHROUGHS

***Brief news flashes on recent important developments in the field of electronics***

• **Detailed, accurate maps of the moon are expected to result from work going forward at Arecibo, Puerto Rico, site of the world's largest and most powerful radiotelescope. Staff members at the Arecibo facility, operated by Cornell University under a U.S. Air Force contract, have established a workable grid pattern for the moon comparable to the imaginary latitude and longitude systems used by map makers on earth. The grid makes it possible to determine where radar signals transmitted from Arecibo strike the moon. A great deal about the surface and other characteristics of the moon can be learned through careful analysis of such radar signals . . .**

• Another entry in the race to produce the world's most powerful superconducting magnet has been announced by RCA—a device that is claimed to produce a magnetic field of 107,000 gauss—214,000 times more powerful than the earth's magnetic field. The magnet, made possible by the development of a method of making a flexible superconducting ribbon of niobium and tin (three miles of this "ribbon" were used to wind the magnet), is expected to have applications in developing new techniques for generating power such as magnetohydrodynamics and controlled nuclear fusion. Other applications will be in plasma research and space propulsion, and in high-energy physics. Superconductivity—the phenomenon of zero resistance to the flow of electricity at very low temperatures—is currently regarded as the only answer to the problem of how to build extremely powerful magnets . . .

• **Electronic "ticket takers" that read magnetically coded Long Island Railroad commuter tickets, cancel one ride, and then activate an "enter" sign and unlock the turnstile, have been installed at two Long Island stations. Under the system, a commuter can buy a one-trip, weekly, or monthly ticket magnetically coded to show his boarding point, destination, and the period during which the ticket can be used. The ticket is inserted in a slot in the turnstile housing and is "read" by a computer which magnetically "punches" it and informs the passenger how many rides remain. If the ticket is spurious or invalid for any reason, it is rejected. The system, manufactured by**

# NOW IT'S A BREEZE

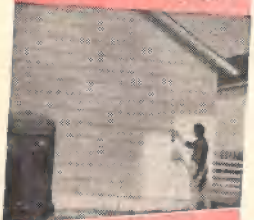
to paint everything
you see here
– including the room –
with the
WORLD'S FIRST ROTARY
ACTION PAINT GUN!

All yours with practically
NO MISTING – NO OVERSPRAY –
CAN'T EVER CLOG IN OPERATION!

ONLY THE SLOAN-ASHLAND
ROTARY ACTION PAINT GUN...

let's you paint a line
so fine you can
write your name ...

cover a full foot-and-a-half swath with one pass...

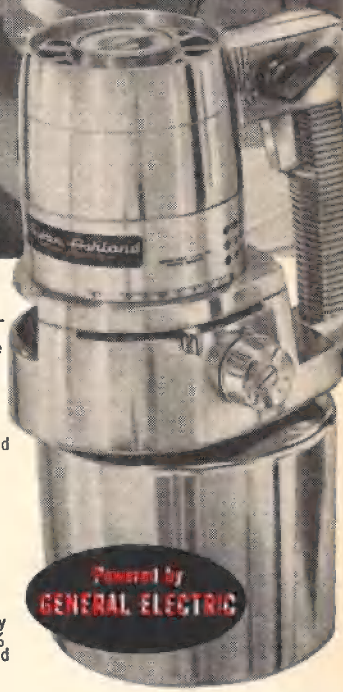


paint within inches ...

Delivers as much paint per minute as a $200 industrial compressor model. HANDLES WATER SOLUBLE, RUBBER BASE, OIL BASE, FLAT, SEMI-GLOSS AND ENAMEL PAINTS. LIGHT OILS . . . INSECTICIDES . . . FLOOR WAXES, POLISHES AND OTHER LIQUIDS.

- No costly compressors
- No nozzles, needles, strainers to clog
- No air hoses to drag
- No flimsy vibrators
- **2-SPEED OPERATION** for perfect control of light and heavy liquids.
- **FINGER-TIP CONTROL OF PAINT FLOW**—trigger lets you start and stop spraying instantly
- **ADJUSTABLE GATE FOR EXACT WIDTH OF SPRAY YOU WANT**—from ¼" to 18"—can't ever clog in operation.

- **CLAMP-ON CAN** holds full quart
- **PAINT VOLUME CONTROL** lets you deliver just the amount of paint desired to the working surface
- For 115V AC operation
- Fully guaranteed
- **ALUMINUM DIE CAST HOUSING** for light weight and rugged durability
- **CAN'T EVER CLOG IN OPERATION** Powerful GE motor and rotary action spin the paint at a steady 17,000 RPM . . . actually makes the Sloan-Ashland Paint Gun impossible to clog in operation!
- Reduces misting and overspray to a minimum. Eliminates 90% of usual masking! No more need to cover everything in sight.




**$59.95**

**AMAZINGLY EASY TO CLEAN OR CHANGE COLORS...**
Fill container with water or proper solvent, run gun for a minute or two. That's all there is to it! No mess, no bother!

FREE **TWO QUARTS OF SPRED-SATIN PAINT**

## Covers 300% more width in each stroke than a 6" brush or roller...

Now you can do 100 Sq. ft. of surface in minutes—because you cover three times as much area on each stroke, with the Sloan-Ashland Rotary Paint Gun. You cover a full foot-and-a-half swath with perfect control. Big job or small . . . inside or outside . . . whether you're spraying paint or other fluids—nothing does the work as quickly, as easily as this amazing paint gun!

Typical Oval Pattern of Ordinary Spray Gun.

Oval spray and wide feathering around edges make precise work difficult, requires extensive masking

"Straight Line" Pattern of Sloan-Ashland Paint Gun.

Straight line spray and minimum of feathering gives you perfect control for the most precise painting

**American Products Division, 589 Broadway, New York 12, N.Y.**
Send me your new Sloan-Ashland Rotary Paint Gun. I may use it for seven days **free**, and return it **at your expense** if I am not fully satisfied.

**Also**—send me two free quarts of Spred Satin Paint **(worth $4.30)** which I may keep and use **whether or not** I agree to buy the Sloan-Ashland Rotary Paint Gun.

If I do agree to keep it, I will pay only $8.50 a month until I've paid the low price of just **$59.95** (plus shipping and handling).

Name____________________
(Please print)
Street____________________
City__________ Zone____ State______
Where employed________________
Home phone number______________

PE9

# BREAKTHROUGHS

(*Continued from page* 26)

**Litton Industries Advance Data System division, has also been undergoing testing at two London Underground (subway) stations . . .**

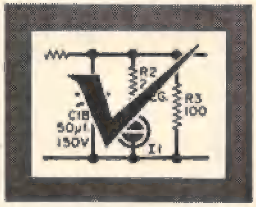
• Plasmajet engines for spaceships, portable torches that boil tungsten and slice through concrete, and new spotlights as bright as the sun are just some of the possibilities inherent in a new type of free-burning plasma generator demonstrated by Columbia University's Electronics Research Laboratories. Heretofore, plasma (an electrically conductive gas most commonly manifested as a brilliant, intensely hot stream) has been generated by passing gas through an electric arc surrounded by a special confining and cooling apparatus. The new device, which is more than twice as efficient, ionizes gas by passing it through a porous graphite electrode *before* it enters the arc. This eliminates the need for confining and cooling, and produces a free-burning, open-air plasma . . .

**• Libraries of the future may be largely computer-operated, with one or more centralized machines serving as a vast storehouse of technical data and general information. The feasibility of such a setup was recently demonstrated by Univac Division of Sperry Rand Corp. which has programmed a Univac 490 at the World's Fair Library/USA exhibit to reproduce on demand reading lists and/or essays on 75 different subjects. In special demonstrations, librarians in St. Louis—a thousand miles away—queried the World's Fair machine and received 700-word printed reports in 20 seconds . . .**

• A method of teaching a computer to handle new problems by "reinforcement," a term borrowed from the psychologists, has been devised by Marion D. Waltz and Prof. King-Sun Fu, Purdue University engineers. Reinforcement—figuratively the "rewarding" of correct solutions and the restudying of incorrect ones—was applied to a simulated analog factory control system. For learning circuitry, a 1620 digital computer was incorporated. The 1620 makes its first decisions by "flipping a coin"—then it examines the results of those decisions. Right choices receive positive reinforcement, meaning that there is a greater chance that the same decision will be made under similar circumstances. Negative reinforcement is given wrong answers . . .

—*W. Steve Bacon*

# Operation Assist




THROUGH THIS COLUMN we try to make it possible for readers needing information on outdated, obscure, and unusual radio-electronics gear to get help from *other* readers. Here's how it works: Check over the list below. If you can help anyone with a schematic or other information, *write him directly*—he'll appreciate it. If *you* need help, send a post card direct to OPERATION ASSIST, POPULAR ELECTRONICS, One Park Avenue, New York, N.Y. 10016. Give the maker's name, the model number, year of manufacture, bands covered, tubes used, etc. Be sure to print or type everything legibly, including your name and address, and be sure to state specifically what you want, i.e., schematic, source for parts, etc. Remember, *use a post card;* we can handle them much faster than letters. And don't send a return envelope; your response will come from fellow readers. Because we get so many inquiries, none can be acknowledged, and POPULAR ELECTRONICS reserves the right to publish only those requests that normal sources of technical information have failed to satisfy.

### Schematic Diagrams

**RCA** "Magic Brain" superhet receiver, Model 9K2. Tunes 150 kc.-60 mc. (Dick Bohl, R.R. #2, Mowrystown, Ohio)

**Howard Radio Co.** Model 435-A receiver, circa 1942. Tunes 4 bands. (Ned A. Hedrick Jr., 1331 Northwest Dr., Pella, Iowa 50219)

**McMurdo Silver** "Orpheon" 7-tube t.r.f. broadcast receiver, 1938. (G. B. Publow, Box 590, Picton, Ontario, Canada)

**Majestic** Model 111 auto radio built by Grigsby-Grunow Co. of Chicago, about 1935. (Jeffrey Boyea, 2280 W. Mangold Ave., Milwaukee, Wis. 53221)

**Sparton** Model 301 receiver, circa 1927. Uses 2 #50, 2 #81, 6 #27 tubes. (Ronald Hattner, 14040 Sherwood, Oak Park 37, Mich.)

**Philco** Model 46-860 receiver, code 121. Covers broadcast and short-wave bands to 22 mc. (Frederico Po, 1573 Doroteo Jose, Sta. Cruz, Manila, Philippine Republic)

**New-Tronics** Model A1 transistorized stereo amplifier, about 20 transistors. (Earl Morwitz, 4222 N. Ashland, Chicago, Ill. 60613)

**Truetone** Model D-911 receiver, chassis 277, 3 bands, 8 tubes. (Darrell Lumpkin, R.R. 1, Modoc, Ind. 47358)

**Meissner** 6-tube a.c.-d.c. radio kit. Tunes 6-18 mc. and 35-160 kc. (Norman F. Swain, 1156 Socorro Ave., Sunnyvale, Calif.)

**Case Electric Co.** neutrodyne broadcast receiver, about 1927. (Jan Johnson, 560 Bloomfield Ave., Bloomfield, Conn. 06002)

**Bendix** RA-10 (CA) ADF receiver, 1942. Tunes 300 kc. to 12 mc. in 4 bands. (J. Hartman, 1121 W. Airport, Lompoc, Calif.)

**E. H. Scott** custom-built receiver, 12 tubes, chrome chassis, ser. 11-137. (J. W. Fraser, 2003 Cherokee Rd., Carpentersville, Ill.)

*(Continued on page 32)*

# Operation Assist

(*Continued from page* 30)

**Airline** (Montgomery Ward) Model 93WG-801A 7-tube receiver, circa 1945. (John Kanbergs, 559 Rocky Way, Redwood City, Calif. 94062)

**Grebe** "Synchrophase" receiver, type MU-1, ser. ZDHC. (John Demerski, 150 Sixth St., Bristol, Conn.)

**Firestone** 4-A-20 "Air Chief" 2-band receiver, code 5-5-9000A. Uses 6 tubes. (C. R. Bush, Jr., 1105 W. 109 Pl., Los Angeles, Calif. 90044)

**Federal Electric** Model D-10 5-tube BC receiver, about 1925. (Jack Allison, 9 Genesee Dr., Commack, N.Y. 11725)

**Silvertone** Model 7057 radio-phono combo with record cutter, ser. 456469. (John Burns III, 234 N. Oxford, Independence, Mo. 64053)

**Philco** Model 42-390 8-tube radio, code 121. Tunes BC, s.w., FM. (John Suemnicht, Rte. 2, Grafton, Wis.)

**Universal Management** 6-tube receiver, ser. 9179, late 1930's. (Michael Peters, R. R. 1, Burnett, Wis.)

**Atwater-Kent** Model 60C 8-tube radio, late 1920's. (Albert Malone, 3 Circle Ave., Mill Valley, Calif.)

**Hibbard** "Supertone" 5-tube a.c.-d.c. portable receiver. **Freed-Eisemann** Model NR-7 neutrodyne battery-operated t.r.f. receiver using 6 201A tubes. (Warren Buell, 608 N. Cherokee Ave., Los Angeles 4, Calif.)

**Howard Communications** Model 718 receiver, ser. 7181252, circa 1938. Tunes 540 kc.-20 mc. in 3 bands. (Gary Noel, 855 Savitt Pl., Union, N.J.)

**Radiotel** Model 1500 receiver, ser. 1586, made by Pacific Electron Products, Long Beach, Calif. (L. J. Potter, 660 Union N.E., Salem, Ore. 97301)

**1155** British aircraft receiver. Tunes 5 bands. Has 9 tubes and "eye." (Terry Mickelson, 324 W. Gorge Rd., Victoria, B.C., Canada)

**Century** Model FC-2 tube tester. (Stephen Ondosh, 309 E. 8 St., New York, N.Y.)

**E. H. Scott** receiver/record player. Tunes 5 bands, has 2 magic-eye tubes, total of 28 tubes. (Jerry Whiteleather, 129 Ogden Ave., Swarthmore, Pa. 19081)

**Midwest** Model S-8 7-tube radio, about 1947. (Edward J. Conroy, 305 Perry St., Buffalo, N.Y. 14204)

**RCA** Model R-32 broadcast console, about 1930, 10 tubes. (Paul Knupke, 1225 Cass Rd., Maumee, Ohio 43537)

**Sparton** (Sparks-Withington Co.) Model 10Y21 receiver, around 1939-1943. (Fred Budig, 315 E. 93 St., New York, N.Y. 10028)

## Special Data or Parts

**Philco** Model 41-95 battery-operated BC receiver, code 121, ser. U 41230. Parts list, service data, and schematic needed. (Paul J. Roggenbuck, Johnston Rd., Port Hope, Mich. 48468)

**Kolster** Model 8B 8-tube radio, 1926, built by Federal-Brandes, Newark, N.J. Schematic and source for UX-112 tube needed. (Jack LaVelle, 4616 W. 152 St., Oak Forest, Ill.)

**Crosley** Model 1526 10-tube radio covering BC to 18 mc. in 3 bands. Schematic and variable capacitor B-135036 needed. (Russell J. Edmunds, 24 Rosslyn Ct., Little Silver, N. J. 07739)

**Wilcox-Gay** "Recordio" tape recorder, Model 8-T-11, ser. 534. Schematic, manual, any other info requested. (F. Cottle, 24 John St. North, Hamilton, Ontario, Canada)

**Case** 5-tube radio, made by Indiana Mfg. & Electric Co., Marion, Ind., in late 1920's; has 3 calibrated dials on front. Any information will be appreciated. (Norman C. Elser, Box 164, Evansport, Ohio 43519)

**Hansen Electric Products** Model M-70 VTVM, ser. P8232. Schematic and instruction manual needed. (Leonard Shustek, 166-15 17th Rd., Whitestone 57, N.Y.)

**BC-1253** UHF transmitter using acorn tube. Frequency range wanted, plus any technical data and schematic. (John D. Griffiths, 38 Lowell Ave., Summit, N.J. 07901)

(*Continued on page* 38)

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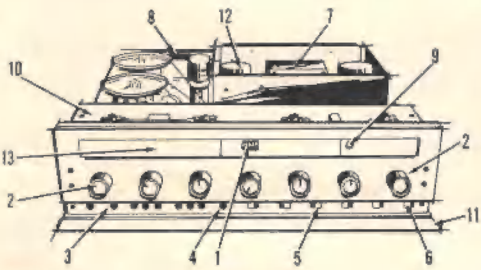


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# Operation Assist

*(Continued from page 32)*

**Philco** Model 41-258 6-tube a.c.-d.c. 2-band receiver, code 122. Parts source needed, especially for coils. (A. D. Benham, RFD #2, Madill, Okla. 73446)

**Walbert Electric Co.** "Penetrola" auxiliary r.f. BC unit. Inductance and capacity values needed. (George Grandy, Box 81, Banning, Calif.)

**Zenith** "Long Distance" receiver, about 1935; tunes BC to 50 mc. in 4 bands. Operating and service manual, schematic, and other data needed. (Frank Crociata, 138 Baycliff Dr., Rochester 4, N.Y.)

**RCA** Model V-215 console 9-tube superhet receiver with 78-rpm phono; tunes three bands. Schematic and owner's manual wanted. (J. H. Kerr, III, 48 W. Arthur Pl., Iselin, N.J. 08830)

**Atwater Kent** Model 46 and Model 20 radios. Source for UX-CX series tubes and 201's wanted. (L. A. Pennypacker, Fleetwood 2, Pa.)

**ASB-3** radar, ser. 1893, made for Navy by Westinghouse, about 1942. Schematic and maintenance manual needed, plus parts. (David Schultz, 414 E. Illinois, Spearfish, S.D.)

**Zenith** 6-tube radio tuning .55-25 mc. Transformer C95-526N or voltage info needed. (Mark Hutchenreuther, 1128 Holyrood, Midland, Mich. 48642)

**RT 159B/URC-4** survival transceiver. Battery info wanted. (Wayne Welsh, 108 Norris St., Mantua, N.J. 08051)

**Grunow** Model 1191, 1191B, 1291, 1297, or 871 receivers. Audio output transformer needed. (Steven Benham, Rte. #1, Box 1526, Bremerton, Wash. 98313)

**T-304/AMT-4A** surplus radiosonde transmitter. Schematic and any technical info wanted. (A2C Randall M. Keils, 1936 Comm. Sq., Box 373, APO 406, New York, N.Y. 09406)

**Philco** Model 46-431 6-tube receiver, code 121; tunes BC and 9.3-15.5 mc. Alignment data and schematic wanted. (Kenneth E. Kaar, 104 Cherokee Dr., Waverly, Tenn. 37185)

**Philco** Model 41-608 radio, code 122. Schematic, source for parts, and FM converter wanted. (Francis L. O'Brien, 100 Seventh Ave., Lowell, Mass. 01854)

**Electronic Tube Corp.** Model H21 dual-channel oscilloscope, ser. 46. Schematic and operating manual needed. (R. L. Panosh, 717 Front St., Lisle, Ill.)

**BC 312/348** Signal Corps surplus receiver. Schematic, manual, source for parts needed. (E. D. Knight, Jr., Box 267, Lewisburg, W. Va. 24901)

**Grebe** Type CR-3 radio, "Grebe Special," ser. 823, made in 1914; tunes 150-1000 meters, has three large coils. Operating instructions needed and any other info available. (Michael Thomas, 12015 S. Stewart, Chicago 28, Ill.)

**Ware** neutrodyne Type T receiver, about 1923, uses three UV 199's. Source for tubes, battery voltages, and other info needed. (R. F. Hill, 386 Roosevelt Ave., Lyndhurst, N.J. 07071)

**RCA** Radoila #3 two-tube regenerative receiver, about 1921. Info on tube types needed. (Robert Lockard, 3185 E. 13th Ave., Columbus, Ohio 43219)

**Atwater Kent** Model 44 seven-tube broadcast receiver. Schematic, alignment data, etc., needed. (J. J. Gatenby, 1566 East Fifth Ave., Vancouver 12, B.C., Canada)

**Heathkit** Model GD-1B grid dip meter No. 341-A low-frequency coil set needed, or at least 544-kc. coil. (G. B. Coss, 9620 Brookshire Ave., Downey, Calif.)

**Radak** receiver, made by Clapp-Eastman Co. about 1914. Schematic wanted, plus info on power supply, battery voltages, etc. (Daniel Ninedorf, R.R. #4, Chilton, Wis. 53014)

**Seeburg** Seletomatic Model M100A. Main drive gear hub needed. (Philip J. Hill, 841 Laguna, Walled Lake, Mich. 48088)

**Bell & Howell** 16-mm. sound projector, Model 179, about 1945. Parts and instruction and/or service manual needed. (Philip J. Hill, 841 Leguna, Walled Lake, Mich. 48088)

**TEC** Model FM-15MX stereo-FM tuner made by Transistronics Inc. Info on how to zero tuning meter needed. (Mike Meltzer, 2617 E. Fayette St., Syracuse, N.Y. 13224) —30—


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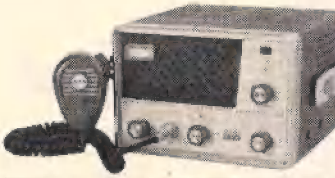

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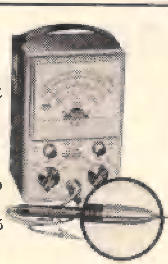

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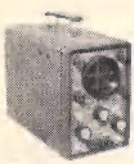

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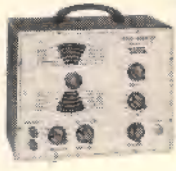

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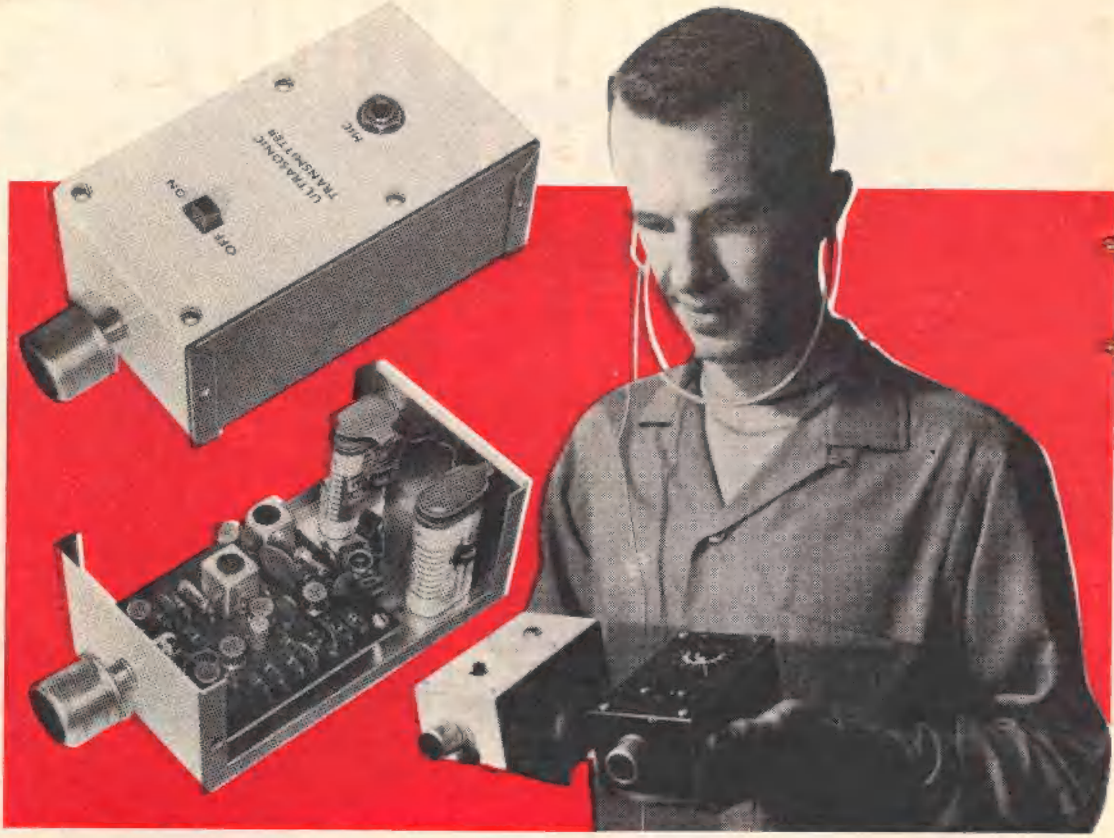
# EXPERIMENTING WITH SONAR

***Use ultrasonics for secret transmissions or demonstrating Doppler shift radar***

**By DANIEL MEYER**

**IF YOU BUILT the "Ultrasonic Sniffer" (March, 1963, issue), you are aware of the unusual sounds that exist in the frequency range beyond human hearing. This companion transmitter permits further exploration of the intriguing, mysterious phenomena of sound energy around 38,000 cycles. Using the transmitter, you can broadcast voice or music on a tight beam that cannot be intercepted with any piece of electronic equipment except the *Ultrasonic Sniffer*. For readers interested in science fair projects, the two ultrasonic units provide an excellent means of effectively demonstrating Doppler shift radar. When both are held by one person and aimed in the same direction, the reflections tell the bearer how fast he is moving and whether he is going towards or away from a fixed object.**

**COVER STORY**




The ultrasonic transmitter is mounted in the same case as the Sniffer. The board is held by spacers and the batteries are clamped to the rear wall with spring clips.

Use the instruments for ultrasonic guidance tests. After a little practice, you will be able to approximate the distance from a reflecting wall by the strength of the echo.

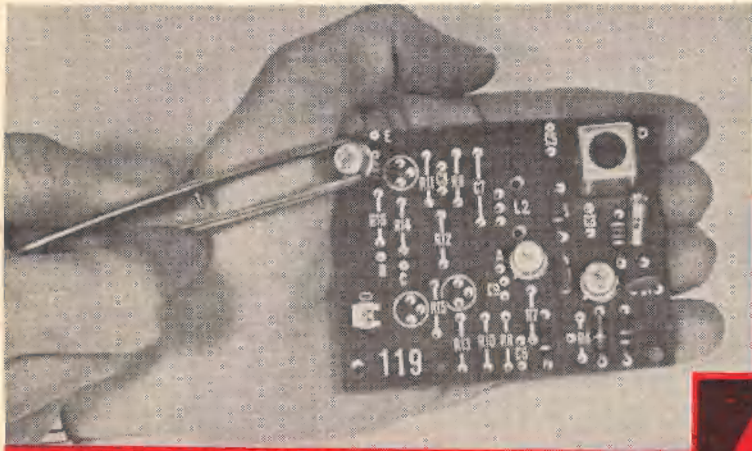
The ultrasonic transmitter described in this article is designed to be modulated by either a carbon microphone or the output from the voice coil of a radio or hi-fi speaker. Either method will work well, and shouting isn't necessary as you cannot increase the range of your transmissions by overmodulating. In fact, distortion would be intolerable and loss of intelligence would result.

The range between the ultrasonic transmitter and the *Ultrasonic Sniffer* will vary according to wind and air motion, but on a clear path (no obstruction between transmitter and receiver) it can be 200-250 feet.

For sonar guidance experiments, the transmitter and *Sniffer* are operated in the c.w. mode so that an audible beat note is heard from ultrasonic reflections from walls, posts, people, etc.

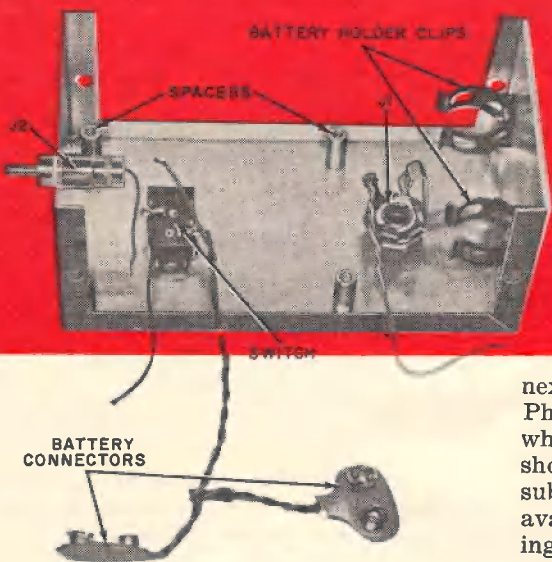
At 38 kc. the wavelength of a sound wave is reduced to about 0.354 inch. Doppler shift—the change in frequency due to motion of either the transmitter or receiver—is easily demonstrated. Holding both the transmitter and the *Sniffer,* a person walking at a normal speed of five-feet-per-second will displace the echo by 170 cycles. This displacement can be heard when these units are operated in the c.w. mode. Movement away from a reflecting surface will lower the beat note while movement toward a wall will raise the beat note.

After a little practice, you will be able to distinguish between hard and soft objects by the amount of echo being returned to the *Sniffer.* It is interesting to try using this equipment blindfolded and guide yourself around your own home by means of echoes.



The printed circuit board needs to have the holes drilled in it for parts mounting. Reverse side is silk-screened for identification. Use care in mounting the transistors to avoid heat damage.

Boards available from author are etched according to this pattern.




Prewire the jacks, switch, and battery clips before mounting the printed circuit board. Use metal spacers to hold the board over the on-off slide switch.

**Constructing the Transmitter.** The small size of the transmitter necessitates the use of a printed-circuit board. The board, special transducer, and coils *L1* and *L2* are available from the author* for $9 postpaid. Holes to mount the components must be drilled by the constructor, but beyond this point construction consists of little more than soldering the components into their plainly marked spaces.

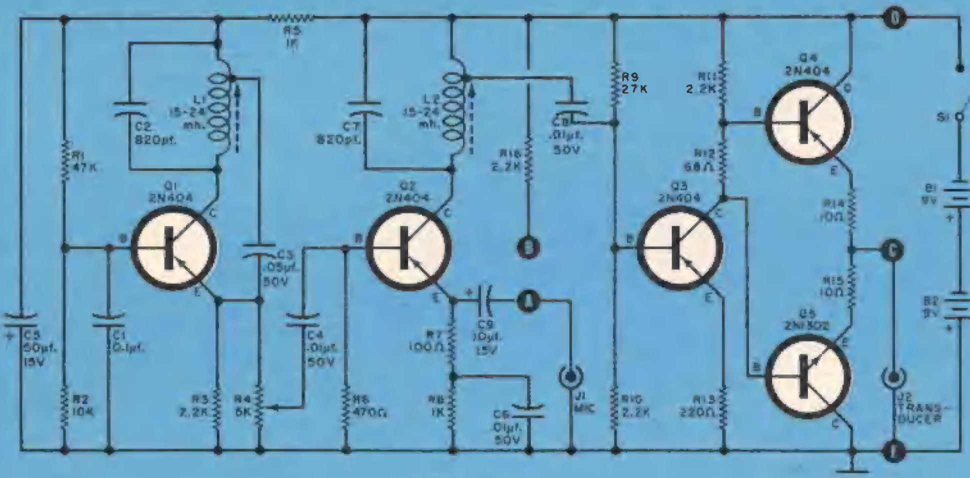
Because of the component size and space limitations, the Parts List on the next page gives complete specifications. Physical dimensions are important, and when making substitutions the builder should bear this in mind, for not all substitute parts can be made to fit the available space. Capacitor voltage ratings are uncritical—as long as they are 15 volts or more. Polarities of small electrolytics must be checked before these capacitors are soldered in place.

Use a small iron for soldering—preferably 25 watts or less. Care must be exercised to flow the solder around the leads and still not damage the parts. Excessive heat will make the copper cladding on the circuit board curl up.

Mounting the board is relatively simple as long as you use the board as a template for marking where the spacers should go. The jacks, battery clips, and on-off switch (*S1*) are positioned and mounted as shown in the accompanying photographs.

The five points marked *A*, *B*, *C*, *D*, and *E* on the board correspond to the identical points in the circuit diagram

**A special package is available from the author for $9 which includes the printed-circuit board, transducer, and coils. Write to Daniel Meyer, 430 Redcliff Drive, San Antonio, Texas 78216.*




**PARTS LIST**

*B1, B2—9-volt battery (Burgess 2N6)*
*C1—0.1-µf., 10-volt disc ceramic capacitor (Centralab UK10-104 or equivalent)*
*C2, C7—820-pf., 5% polystyrene capacitor (Centralab CPR-820 or equivalent)*
*C3—0.05-µf., 50-volt disc ceramic capacitor (Centralab CK-503 or equivalent)*
*C4, C6, C8—0.01-µf., 50-volt disc ceramic capacitor (Centralab CK-103)*
*C5—50-µf., 15-volt, single-ended electrolytic capacitor*
*C9—10-µf., 15-volt, single-ended electrolytic capacitor*
*J1—Microphone jack (Switchcraft Type 11)*
*J2—Transducer jack (Switchcraft Type 3501FP)*
*L1, L2—15-24 mh. variable inductor**
*Q1, Q2, Q3, Q4—2N404 transistor*
*Q5—2N1302 transistor*
*R1—47,000 ohms*
*R2—10,000 ohms*
*R3, R10, R11, R16—2200 ohms*
*R4—5000-ohm trimmer potentiometer (Lafayette Type VC-58 or equivalent)*
*R5, R8—1000 ohms*
*R6—470 ohms*
*R7—100 ohms*
*R9—27,000 ohms*
*R12—68 ohms*
*R13—220 ohms*
*R14, R15—10 ohms*
*(All resistors ½ watt)*
*S1—S.p.s.t. slide switch*
*1—Ceramic microphone transducer (Euphonics U-3842-39)**
*1—Printed-circuit board**
*1—2⅛" x 3" x 5¼" aluminum utility box (Bud CU2106)*
*4—6-32 x ½" metal standoffs or threaded spacers (Herman Smith 2122 or equivalent)*
*Misc.—Battery clips, wire, solder, etc.*
*Available from author as part of $9 package

illustrated above. The microphone jack (*J1*) is grounded to the case and the center terminal attached to point *A*. If a carbon mike is used, the voltage is obtained from point *B*. The transducer is connected (with short wire leads) to points *C* and *E* and one side of the switch to point *D*.

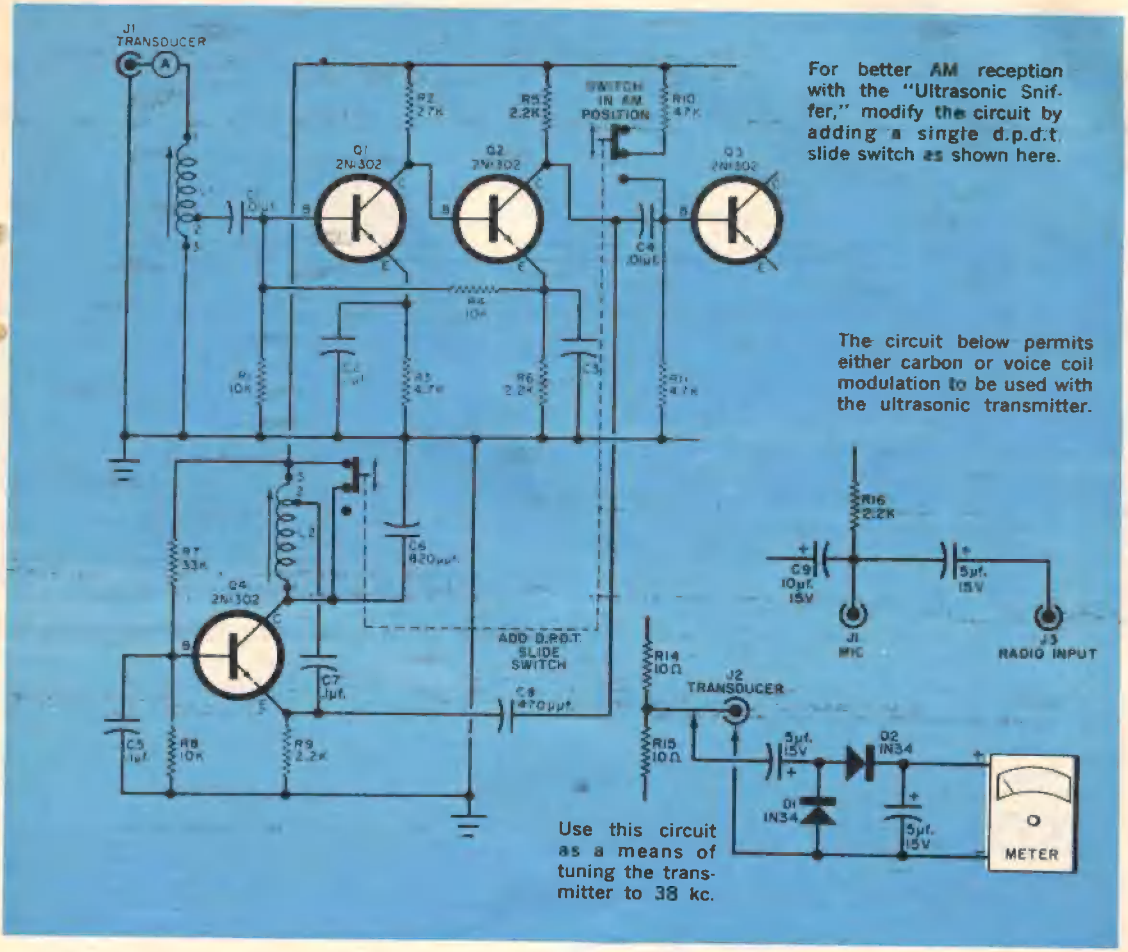
**How the Transmitter Works.** To generate the ultrasonic signal, transistor *Q1* is made to oscillate at 38 kc. The frequency-determining elements are *L1* and *C2*. Oscillation occurs because of the positive feedback through *C3* from the tap on *L1*. The output of *Q1* drives the base of *Q2*, the collector of which is also tuned to 38 kc. through *C7* and *L2*. When voice is transmitted, *Q2* doubles as the modulator.

Transistor *Q3* is used as a linear amplifier to drive the power output transistors (*Q4* and *Q5*). The transistors in this latter stage are connected as complementary emitter followers to provide the low impedance source needed to drive the transducer.

Power for the transmitter is derived from two 9-volt batteries in series. Only one control appears on the top panel of the transmitter—on-off switch *S1*.

**Tuning Up.** Before "buttoning up" the transmitter, coils *L1* and *L2* must be tuned up, and drive potentiometer *R4* set for best voice transmission potential. If you have an audio signal generator that will tune up to 38 kc., the alignment procedure is quite simple, but the following alternate method will give equally effective results.

Connect a 20,000-ohm-per-volt VOM to a circuit consisting of two capacitors and two low-voltage signal diodes as shown in the bottom diagram on the next page. Turn out the tuning slug of




For better AM reception with the "Ultrasonic Sniffer," modify the circuit by adding a single d.p.d.t. slide switch as shown here.

The circuit below permits either carbon or voice coil modulation to be used with the ultrasonic transmitter.

Use this circuit as a means of tuning the transmitter to 38 kc.

*L1* until it is raised flush with the top of the coil housing can. Now reverse the direction of slug travel and turn the slug three turns back into the coil. Set *R4* at about one-fourth turn from the counterclockwise stop.

With the batteries in place and connected, turn the transmitter on and make sure there is a reading on the VOM. Use the lowest possible voltage scale. The exact reading is immaterial.

Using a nonmetallic tuning tool, adjust the slug in coil *L2* for a maximum reading on the meter. Turn drive potentiometer *R4* backwards to reduce the output reading to zero, then slowly turn *R4* clockwise and watch the VOM carefully. The readings will increase and then stop regardless of further rotation of *R4*. Note the maximum reading, divide it in half, and reset *R4* so that the meter reads this latter amount. You have now tuned the transmitter and set it up for best voice transmission qualities.

The modulator requires about 0.25 volt from a low-impedance source to drive the transmitter to fully modulated output. A good carbon mike will give you this output, or you can modulate the transmitter with a speaker voice coil. If the latter is used as a source of modulation, reverse the polarity of *C9* and do not connect point *B*. You can use both mike and voice coil by adding a second jack and another capacitor according to the small circuit above.

**Modifying the "Sniffer."** If you built the *Ultrasonic Sniffer** from plans appearing in either the March, 1963, issue of POPULAR ELECTRONICS or the 1964

(*Continued on page* 102)

**A printed-circuit board, necessary coils, and ceramic transducer for the Sniffer are also available from the author for $9 postpaid.*

# THE HI-LIGHTER

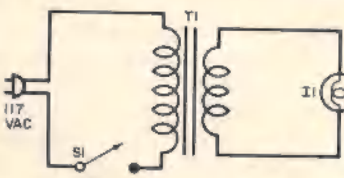
***Why spend more than $15 for a high-intensity lamp when you can construct it for under $5?***

**By BYRON G. WELS**
Feature Editor

HIGH-INTENSITY lamps are all the rage now. And it's no wonder when you consider that they produce a tremendous amount of light and that this is ideal for doing close-up work. The author uses the "Hi-Lighter" for editing and splicing tape. It throws an intense white light on the work area, and leaves the balance of the room in darkness, eliminating annoying distractions.

To make the "Hi-Lighter," you'll need a 6-volt automobile bulb, the GE-1133, which is rated at 32 candlepower and 3.91 amperes. The bulb (*I1*) and its socket fit nicely in a frozen juice can which, when painted, forms the shade. A flexible gooseneck can be obtained from your local lamp supplier or electrical shop. The base is the familiar Minibox, with ordinary pencil erasers (held in place with epoxy cement) serving as feet. Transformer *T1* is a 6.3-volt filament transformer with a capability of at least 4 amperes—less amperage won't give you full brightness. Switch *S1* is a simple s.p.s.t. toggle switch.

After washing and drying the juice can, drill two holes in the bottom to mount the lamp socket. A third hole, 3/8" in diameter, is required to mount the gooseneck, and this should be drilled right on the seam of the can for best appearance. Center-punch all holes before drilling, and work carefully as the metal is soft and thin. Then deburr the holes with a large drill, and paint the outside of the can—the author used bright gold Krylon spray, but any color could be used. When the outside paint has dried thoroughly, carefully mask the entire outside of the can, and spray the interior a gloss white.




Simple circuit above is easily wired. Solder all connections and use tape or wire nuts over T1's wires to insulate them.

When the inside paint is dry, remove the masking, and attach the can to the gooseneck. Attach the Minibox base to the lower end of the gooseneck. Cut a length of lamp cord (a.c. wire), connect one end to the socket, and mount the socket in place. Snake the other end through the gooseneck, and connect it to the transformer which is mounted in the Minibox. Wire the transformer primary to the switch and line cord as shown. The transformer connections should be taped or covered with wire nuts. And make sure that all exposed connections are insulated from the Minibox to prevent shock hazard.

You may be interested in experimenting with other handy materials that might serve as a shade. Also, collapsible curtain rods can be adapted to form a support bracket in place of the recommended gooseneck. However you decide to make the lamp, one thing is sure—it's an illuminating project! —30—

# THE FABULOUS FUEL CELL

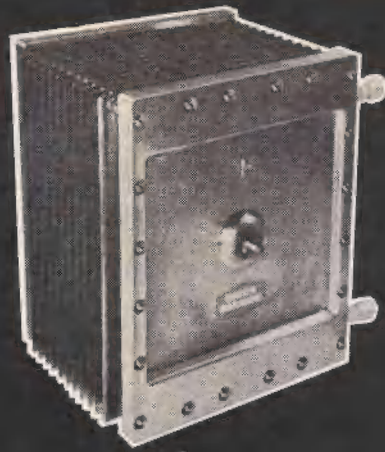
New electrode materials are constantly being evaluated in the search for reliable, economical fuel cells. At left, a G.E. researcher tests electrode material with electrolytes of varying acidity and alkalinity.

By **WALTER G. SALM**

**Even as you read this, the first fuel cells are on their way into space. Tomorrow? Fuel cell-powered cars are just one possibility**

ONE DAY in the not-too-distant future you may be able to drive into a gas station, pull alongside a pump labeled "methane," and order a tankful for your car.

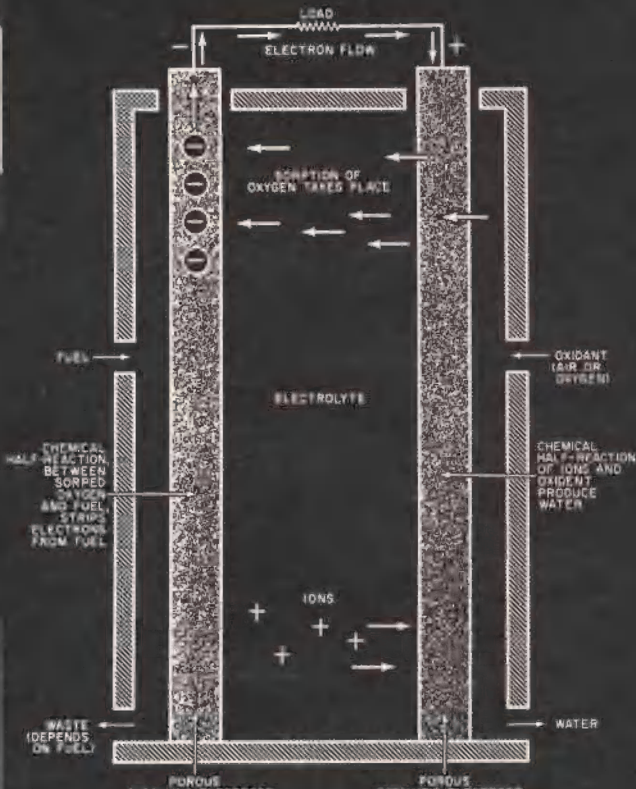
You won't be driving some new breed of jet or turbo-powered chariot, but a car with a power plant that is as old as the automotive industry itself—an electric motor. The unusual feature of this car will be the part that provides the electricity, a new kind of generating device that gulps a variety of inexpensive gases and produces power. The device is called a fuel cell, and while it is still experimental, companies working on its development have already reported progress that seems almost unbelievable.



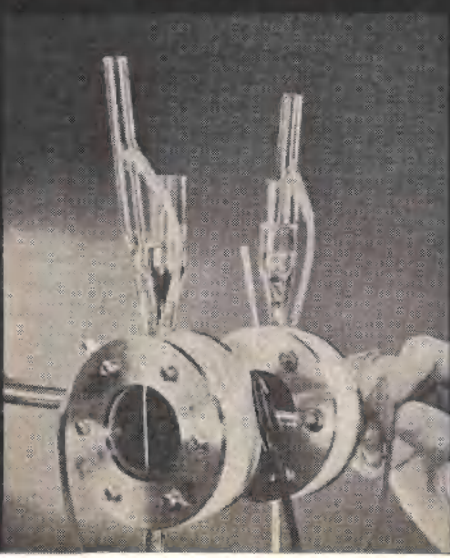
The 12" x 14" fuel cell module at right uses economical carbon electrodes combined with a minimum of precious metal catalyst. Made by Union Carbide, it is a hydrogen-oxygen low-temperature unit.


A hydrogen-oxygen fuel cell, circa 1959, shows immense progress that has been made in a few years. Object at right of G.E. cell is a motor with a propeller.

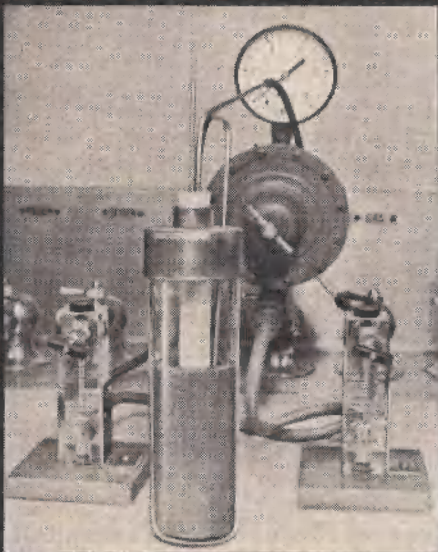
A recent development is a cell that uses inexpensive hydrocarbon fuels and oxygen. Devised by Dr. Thomas Grubb and Dr. Leonard Niedrach of G.E., the cells shown below operate on such fuels as diesel oil, gasoline, and propane gas.




This generalized drawing shows basics of fuel cell operation. The electrolyte may be liquid, semiliquid, or solid; the electrodes can be carbon, plastic, platinum or nickel boride, typically in combination. Fuel depends largely on the type of electrode used; hydrogen reacts very easily, but inexpensive hydrocarbons are now being used thanks to improvements in cell electrodes.



This experimental high-temperature fuel cell uses a solid zirconia electrolyte (white cylinder). The dark cylinder is a graphite electrode. Cell uses natural gas and oxygen to generate electricity.



Below is a cutaway mockup of one of the fuel cell canisters installed in Gemini. Fuel cell modules — the first may be in orbit when you read this—produce drinking water for astronauts as well as up to two kilowatts of electrical power.

The fuel cell is a kissing cousin of the more conventional electrochemical batteries that we use every day. Like batteries, it works through a chemical reaction that produces a lot of free electrons. But unlike batteries, it can be "refueled" by replacing chemicals that have been consumed in the reaction, and it will continue to function at normal operating levels all the while. And what operating levels they are! Fuel cell modules have already been constructed with *continuous* outputs of *2.5 kilowatts.* When discussing characteristics and life tests, it is customary to refer to a cell in terms of amperes-per-square-foot (of electrode surface), and these figures are normally several hundreds of amperes for a typical fuel cell configuration.

To understand just what all the noise is about, let's take a quick look at conventional batteries and the way they produce electricity. Dry cells, whether of the zinc-carbon type used in flashlights or the more sophisticated alkaline variety, all produce electric current by means of the chemical reaction that goes on between certain key materials—the electrodes and the electrolyte. The electrolyte is a liquid or semiliquid that reacts chemically with the negative electrode, usually zinc, producing many free electrons. The electron stream returns through the load to the positive electrode and moves through the electrolyte to the negative electrode where the electrons are again freed by the chemical action.

This chemical action consumes both the negative electrode and the electrolyte. In dry cells, the result is a dropping off of the cell's productivity; eventually the cell must be discarded. In wet-cell batteries such as the automotive type, if the consumption of negative electrode and electrolyte has not progressed too far, the chemical action can be reversed by applying a direct current to the battery terminals to recharge it. The ability to be recharged draws a distinct line between two battery types. *Primary* batteries cannot be recharged; *secondary* batteries can.

**Enter the Fuel Cell.** Although there are many similarities between a fuel cell and a primary battery, the big difference is that the electrodes and electrolyte used

This fuel-cell-driven golf cart made by Allis-Chalmers shows the feasibility of putting fuel cells to work powering vehicles. A fuel-cell-operated farm tractor was demonstrated by firm as early as 1959.

in the fuel cell are not changed or consumed during the operating life of the device.

The zinc (or magnesium or lead) electrode used at the anode in a primary battery cell actually serves two purposes—that of an electrode and that of a "fuel" which is consumed as the cell wears out. The electrodes used in a fuel cell are not used as fuel. The fuel—hydrogen, hydrocarbons, etc.—is continuously fed to the cell from an external source.

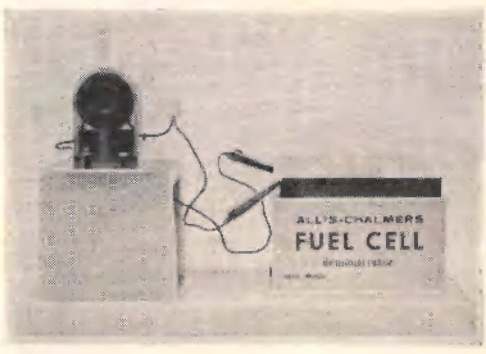
As shown in the generalized drawing of a fuel cell (p. 48), the chemical reactions that produce a flow of electrons in the external circuit take place in the cell's *porous catalytic electrodes.* This terminology largely explains the function of the electrodes: they absorb fuel and oxidant by virtue of being porous, and promote a reaction between the two which generates electricity. Producing the perfect electrode for fuel cells is one of the big problems that has stumped researchers ever since a brilliant scientist, W. R. Grove, conducted experiments with elementary fuel cells back in 1839. Carbon and polymer plastics have been used for electrodes. More recently, spongy platinum and nickel boride have come along. Without laboring the point, producing *economical* electrodes that can promote and contain fuel cell reactions without themselves changing is no mean trick.

In operation, the two electrodes of a hydrogen-oxygen fuel cell absorb their gases by diffusion, the anode taking on oxygen and the cathode hydrogen. The two electrodes are separated by a liquid or solid electrolyte, and the reaction takes place at the surface where the electrolyte makes contact with the electrodes.

When the oxidant (air or oxygen) reaches the cathode of the fuel cell, it is absorbed by the cathode and enters the electrolyte in a process called "sorption." The exact mechanism by which sorption (a general term meaning the same as "absorption" but used when the phenomenon is unknown or indefinite) of the oxygen takes place remains one of the mysteries of fuel cell operation. On reaching the anode, the oxygen combines with the fuel absorbed by the anode and oxidizes it, producing electricity in the process.

Amazing as it may seem, no heat is

(*Continued on page* 94)

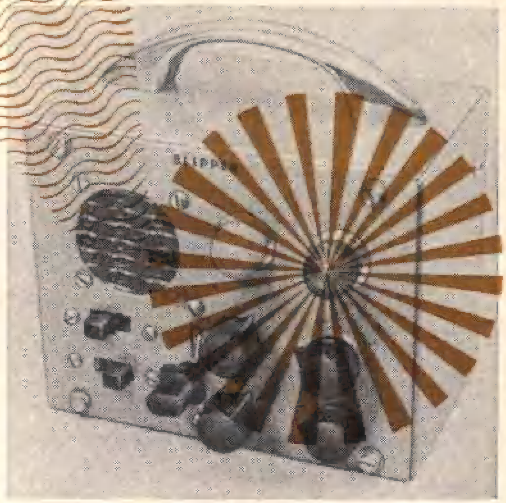



A classroom demonstrator of fuel cell principles, this working model created by Allis-Chalmers uses either alcohol or sodium or potassium hydroxide as fuel, and hydrogen peroxide as an oxidant. Platinum, silver, and nickle electrode plates are positioned in tank at right, and the two end plates connected to the miniature electric motor furnished with the model. Priced at $9.75, model is available from Science Materials Center, Inc., 220 East 23 St., New York, N.Y. 10010, less necessary fuels.

# Build the BLIPPER

By NORBERT SMITH, W5MQL

**The Blipper is an interesting toy that will amuse a child (or adult) hour after hour after hour after . . .**



Change the positions of the unmarked (!) controls to get variations in both what you see and hear.

TOO OFTEN, when you buy a gift for a child, he opens the box, takes out the lovely present, and proceeds to play with the box! Few children will be able to resist the "Blipper." There are fascinating knobs, levers, and switches; there are bulbs that light; there are squawks, whistles, and chirps. In short, it makes a delightful toy. Many children may find it so absorbing that they even neglect the TV set for it!

The Blipper is actually two circuits, one being an audio oscillator, the other a free-running multivibrator. They can be used individually or in combination with each other.

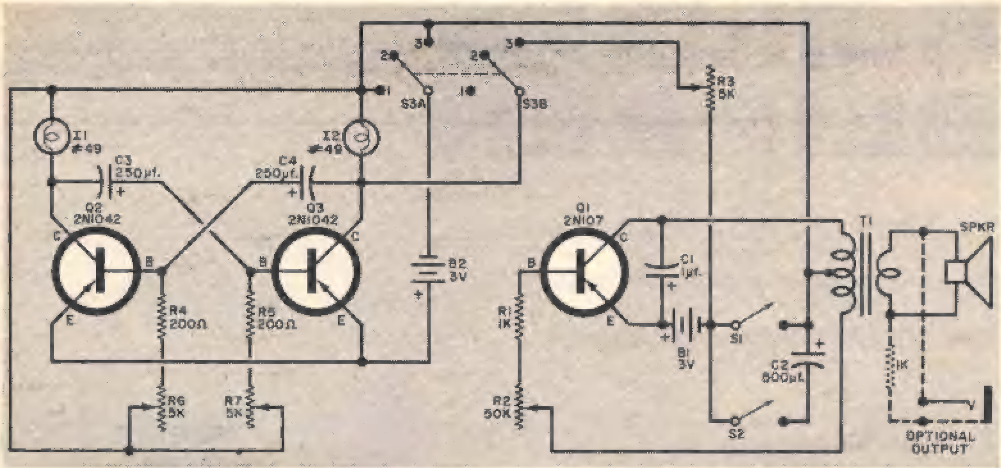
**Tone Oscillator Circuit.** Transistor *Q1* is the audio oscillator, with resistor *R1* limiting base current to a safe value. Potentiometer *R2* controls the oscillator tone by controlling the amount of feedback from collector to base. The inductance of the primary of transformer *T1* and capacitor *C1* determine the frequency range, and the value of *C1* can be changed to suit the builder.

Switch *S1* turns the oscillator portion on and off, independently of the multivibrator circuit, and could be replaced by a key for code practice use. Switch *S2* throws an additional large capacitor (*C2*) across switch *S1* to hold and fade the charge after *S1* has been opened. This produces some nice "chirpy" or "siren" tones. Additional capacitors and switches could be added if you wish.

**The Multivibrator.** Transistors *Q2* and *Q3* form a free-running multivibrator with lamps *I1* and *I2* as their respective collector loads. Feedback is obtained via capacitors *C3* and *C4* while the time constant is regulated by the settings of potentiometers *R6* and *R7*. Resistors *R4* and *R5* limit base current to the transistors; *R6* and *R7* control the "on" time of the transistors, allowing an endless ratio of "on" to "off" time of the two bulbs, or a weird variety of sounds when the multivibrator is used to control the audio oscillator.

Lever switch *S3* is a function switch. When it is in position 1, only the lights flash. Position 2 is the "off" position, and in position 3 both lights and audible tone are present. In this third position, three volts is taken from across lamp *I2* when transistor *Q3* is conducting. This is applied through the feedback control (potentiometer *R3*) to switch *S1*—which must be open—turning on the oscillator when lamp *I2* is lit. When capacitor *C2* is introduced into the circuit (by closing switch *S2*), it smooths the pulsating tone down to a constantly varying tone, with potentiometer *R2* controlling the pitch.

**Building the Blipper.** Construction is simple and direct. Nothing is at all critical, so component values, lead dress and layout are pretty much *ad lib.* The author used miniature potentiometers and a miniature (2-inch) speaker so




## PARTS LIST

*B1—Two 1.5-volt "AA" penlight cells in series*
*B2—Two 1.5-volt "C" flashlight cells in series*
*C1—1.0-µf., 35-volt electrolytic capacitor*
*C2—500-µf., 10-volt electrolytic capacitor*
*C3, C4—250-µf., 10-volt electrolytic capacitor*
*I1, I2—GE #49 2-volt pilot lamp*
*Q1—2N107 audio transistor (or CK722 or equivalent)*
*Q2, Q3—2N1042 transistor (or 2N1038—see text)*
*R1—1000-ohm, ½-watt resistor*
*R2—50,000-ohm miniature potentiometer*
*R3, R6, R7—5000-ohm miniature potentiometer*
*R4, R5—200-ohm, ½-watt resistor*
*S1, S2—S.p.s.t. slide switch*
*S3—3-position, 2-pole lever-action switch*
*T1—Miniature output transformer, 500-ohm push-pull to 8-ohm output*
*Spkr—2" loudspeaker, 8-ohm voice coil*
*1—3" x 4" x 5" utility box (Bud CU-2105-A or equivalent)*
*Misc.—Output jack, lamp holders, insulated battery holders, pegboard, wire, solder, etc.*

that the Blipper could be housed in a 3" x 4" x 5" Bud utility box.

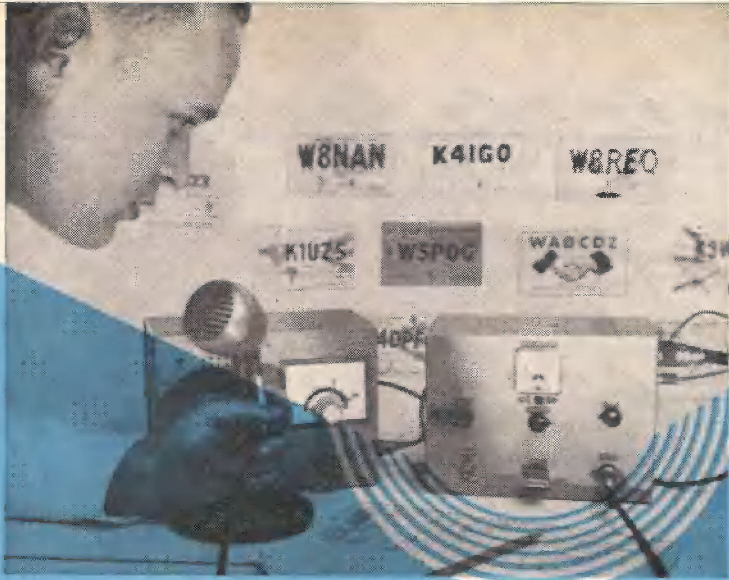
Pegboard makes a handy foundation for the small parts. Remember to observe battery and capacitor polarity when you wire them in place, and be sure to use a suitable heat sink—such as a pair of pliers—when soldering the transistors in place. While any small audio transistor will suffice for *Q1*, stick to a *pnp* type to avoid confusing polarity reversals. A less expensive substitute can be used for the 2N1042's, provided that the transistor chosen can handle about 100-ma. collector current. The GE #49 lamps were selected for the low amount of current they draw; substituting other lamps may result in shortened battery life or exceeding the transistor current limitations.

You can modify the circuit to include an output jack, but the speaker should be left in the circuit as its reflected impedance will influence the oscillator. If a separate jack output for tape recording is desired, a 1000-ohm resistor should be added between the jack and speaker to provide additional isolation, as shown in the schematic diagram.

**Blipping the Blipper.** If the gadget is intended as a novel toy for kids, no explanation of how it operates is required—just give it to a child and watch. But in the hands of a curious adult, the Blipper can be even more fun! Here's a brief rundown on the controls and what they do.

Closing *S1* will produce a pure, steady tone, while *R2* will vary the pitch or frequency of the tone. Opening and closing *S1* rapidly will (with *S2* closed) produce a weird, chirpy sound, especially at the higher frequencies. When the multivibrator is used, *R3* will completely fade the pulsating sound without too great a change in frequency. Potentiometers *R6* and *R7* could be ganged if you want to change the repetition rate without changing the ratio of "on" and "off" time of lamps *I1* and *I2*.

With a little imagination and a bit of practice, children can become quite proficient in the use of the Blipper, much to the envy of their friends and to the pride of their family. If *you* want to entertain and confuse *your* friends, add a few more "do-nothing" knobs to the Blipper. —30—




# THE COMPANION 6-METER TRANSMITTER

***Just two tubes and a power supply give you a 6-meter phone transmitter that's hard to beat for simplicity***

By **CHARLES GREEN,** W3IKH

WANT TO KNOW how you can put a high-quality 6-watt, 6-meter phone signal on the air at a rock-bottom price? It's easy—just build this beautifully simple three-tube (counting the rectifier) "Companion Transmitter." Although this attractive little rig was designed to complement the "Simple Superhet for 6" which appeared in the April, 1963, issue of POPULAR ELECTRONICS, it can be used with any 6-meter receiving setup.

Designed for easy construction, the Companion Transmitter incorporates two 6CX8's, combination triode-pentodes (*V1b* and *V2b* have internally connected suppressor grids) ordinarily used in TV receivers. In the r.f. section, the triode portion of one 6CX8 (*V1a*) functions as a crystal overtone oscillator using standard FT-243 8-9 mc. crystals to produce an output in the 25-mc. region.

The pentode section of the 6CX8 (*V1b*) in the r.f. section is both a doubler and final amplifier; this type of circuit was chosen as it does not require neutralization. The plate circuit pi-network matches the r.f. output to an antenna of 50 to 72 ohms impedance.

As shown in the schematic on page 55, a second 6CX8 does duty as a speech amplifier-modulator. The mike input signal from *J4* is amplified by *V2a* and fed through *C15* to the grid of *V2b*. The signal is further amplified by *V2b* which modulates the r.f. output by means of the inductance of *T1* which is common to the plate circuits of both *V1b* and *V2b*. Only the primary winding of *T1* is used.

Metering of the final is provided by *M1*, connected to measure either grid or plate current using switch *S1*. Rotary switch *S2* is a d.p.d.t. type which switches the antenna and receiver and transmitter B-plus supplies when going

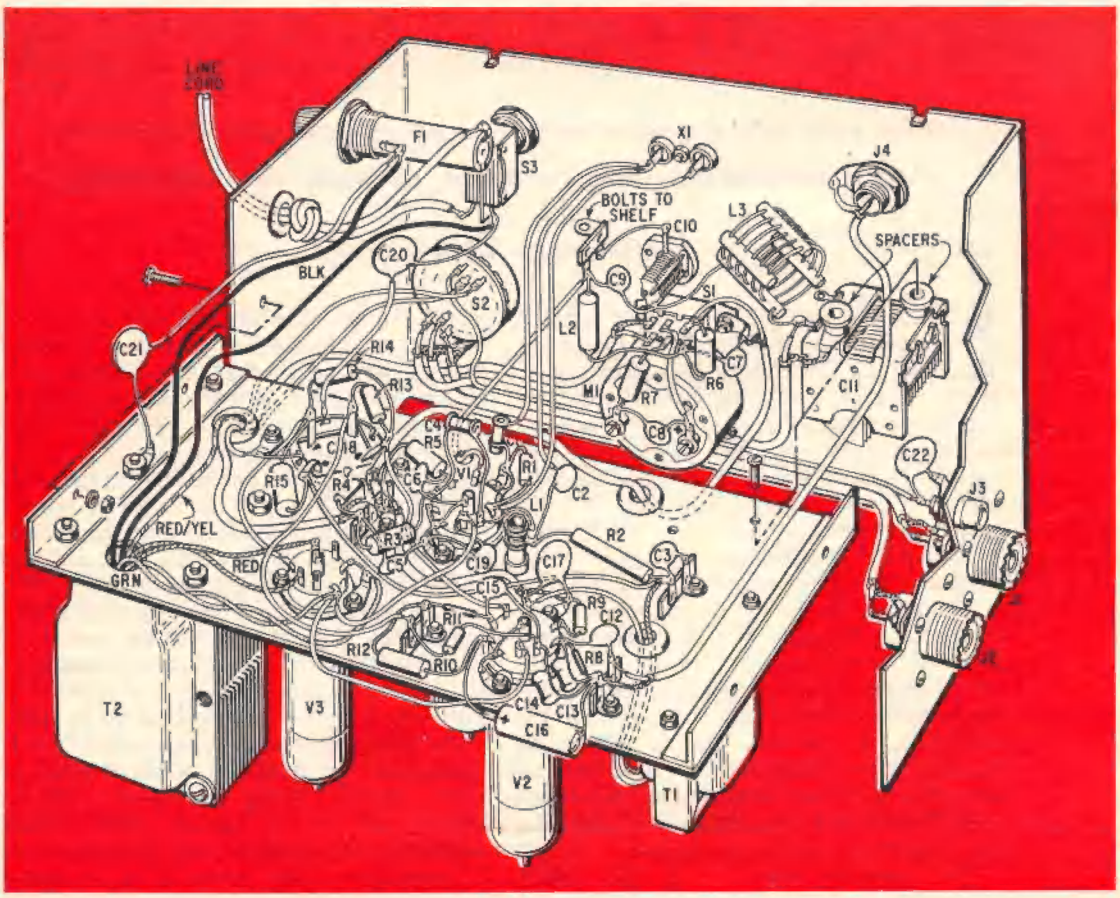
from receive to transmit. A 6X4 rectifier (*V3*) and the *RC* filter circuits of *C18* and *R13*, *R14*, *R15* deliver the required B-plus voltages to the transmitter circuits.

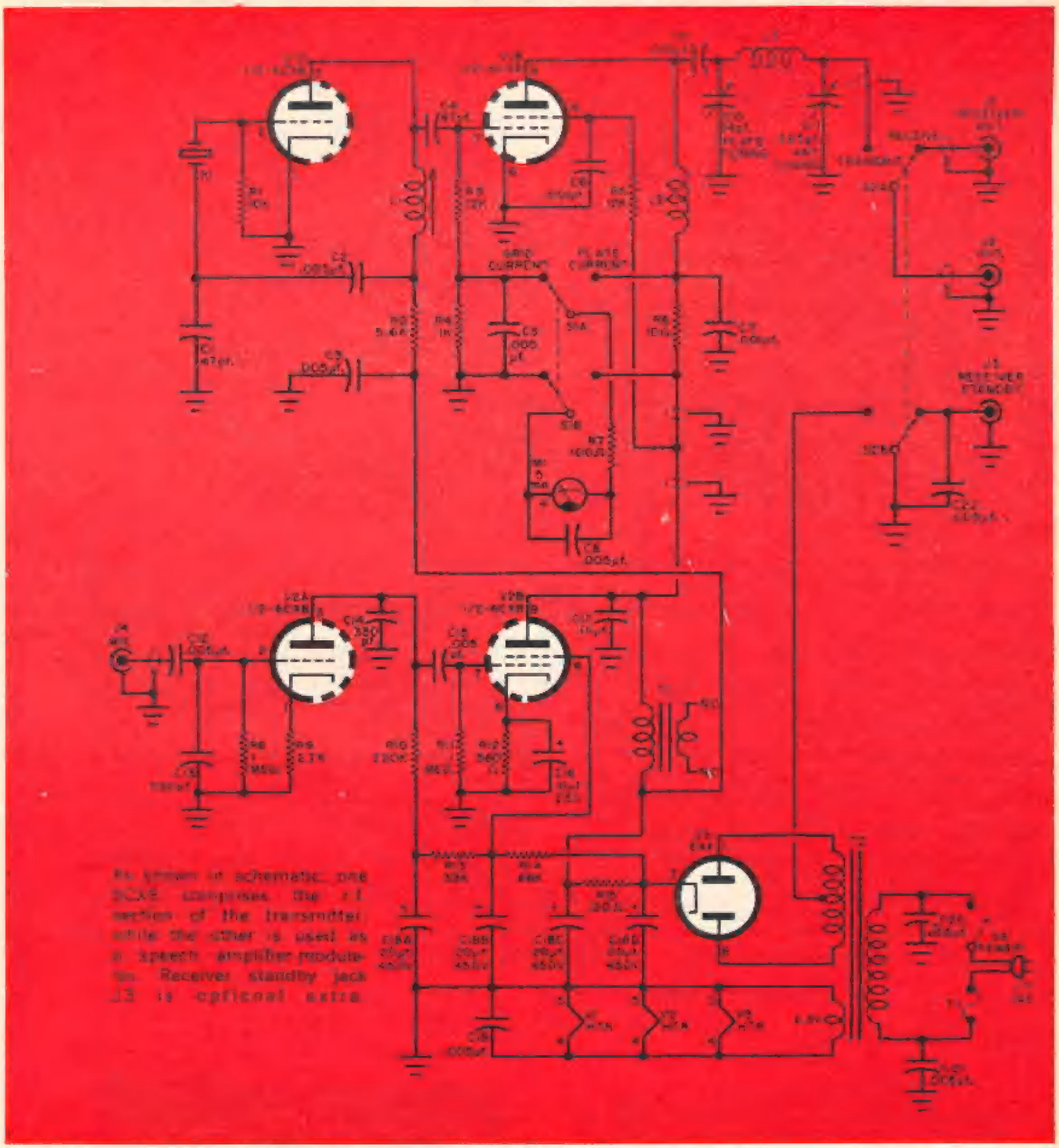
**Layout and Construction.** To simplify construction, the bulk of the transmitter is built on a 4½" x 8" piece of aluminum. As shown in the photographs and pictorial diagram, this piece of aluminum is mounted 2" from the bottom of a 4½" x 6" x 8" utility box with aluminum angle stock. It will pay you to follow the layout shown as closely as possible, as lead length and component placement are relatively critical at 6 meters. Grouping the components on the chassis before you cut the mounting holes will help you determine the best layout.

Antenna tuning capacitor *C11* is mounted on the top of the chassis shelf with two ⅜" spacers to clear its Bakelite end plates. Bend up the unused lugs. Mount a single-lug terminal strip under one of the mounting screws of the filter capacitor (*C18*) on the chassis top to connect *C9* and *L2* to the plate lead from *V1b*. Drill a hole for this lead, and position it so it does not touch the chassis. Position *C9* annd *L2* at least ½" away from *V1*'s envelope, and make their leads as short as possible. The shielded wire to meter switch *S1* should be positioned against the front panel, away from pi-network coil *L3*.

The leads going from *J1*, *J2*, *J3*, and from the junction of *C11-L3* to transmit switch *S2* should be positioned over the top of the back of meter *M1* and taped together. All of the leads except that going from *J3* are made of RG-58/U coaxial cable. The secondary leads of *T1* are not used, and should be cut short

Layout is shown in pictorial below. For approximate spacing, see right photo on page 56.






As shown in schematic, one 6CX8 comprises the r.f. section of the transmitter while the other is used as a speech amplifier-modulator. Receiver standby jack J3 is optional extra.

and taped. In completing the Companion Transmitter, make sure the meter switch is labeled correctly: "G" for grid drive and "P" for plate current. Drill a 3/8" hole in the top of the box for adjusting grid drive coil *L1,* and cut a row or two of holes in the back of the box cover for ventilation.

**Testing and Adjustment.** Insert the tubes in their sockets and a good active crystal in the front panel crystal socket. Place the cover on the transmitter, install a 52-ohm dummy load at jack *J2* and let the unit warm up for a minute or two. Set switch *S1* to measure grid current, and insert a plastic alignment screwdriver through the access hole in the cover onto the adjustment slug of coil *L1*.

Depress transmit switch *S2* and adjust the grid current to 2 ma. This adjustment should be made as quickly as possible to prevent damage to the tube. If the grid current adjustment cannot be

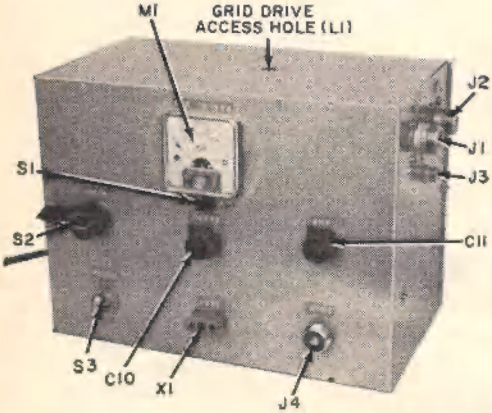
## PARTS LIST

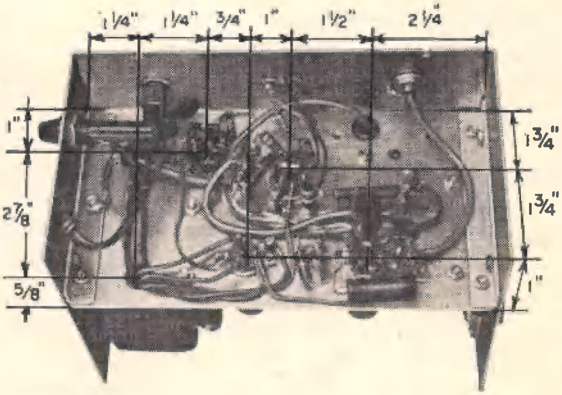
*C1, C4—47-pf., 600-volt ceramic tubular capacitor*
*C2, C3, C5, C8, C12, C15, C19, C20, C21, C22—0.005-μf., 1000-volt ceramic disc capacitor*
*C6, C7, C9—0.001-μf., 1000-volt ceramic disc capacitor*
*C10—14-pf. miniature variable capacitor (E. F. Johnson Type 160-107 or equivalent)*
*C11—365-pf. variable capacitor (Lafayette MS-214 or equivalent)*
*C13, C14—330-pf., 1000-volt ceramic tubular or mica capacitor*
*C16—10-μf., 25-volt electrolytic capacitor*
*C17—0.01-μf., 1000-volt ceramic disc capacitor*
*C18—Four-section electrolytic capacitor, 20 μf., 450 volts per section*
*F1—1-amp type 3AG fuse in panel-mounting fuse holder*
*J1, J2—Chassis-mounting coax receptacle (Amphenol 83-1R or equivalent)*
*J3—Phono pin jack, single-hole mounting*
*J4—Microphone connector, male, chassis-mounting (Amphenol 75-PC1M or equivalent)*
*L1—3.3-μh. to 4.1-μh., miniature adjustable r.f. coil (J. W. Miller Part No. 20A336RBI)*
*L2—7-μh. r.f. choke (Ohmite Z-50 or equivalent)*
*L3—6 turns of B&W "Miniductor" Type 3010 with ⅜" leads (coil size $\frac{11}{16}$" x ¾" dia.)*
*M1—5-ma. d.c. panel meter*
*R1—10,000-ohm, ½-watt resistor*
*R2—5600-ohm, 2-watt resistor*
*R3, R5—12,000-ohm, 1-watt resistor*
*R4—1000-ohm, ½-watt resistor*
*R6—10-ohm, ½-watt resistor*
*R7—100-ohm, ½-watt resistor*
*R8, R11—1-megohm, ½-watt resistor*
*R9—2700-ohm, ½-watt resistor*
*R10—220,000-ohm, ½-watt resistor*
*R12—560-ohm, 1-watt resistor*
*R13—33,000-ohm, 1-watt resistor*
*R14—68,000-ohm, 1-watt resistor*
*R15—120-ohm, 1-watt resistor*
*S1—D.p.d.t. slide switch*
*S2—D.p.d.t. rotary switch, non-shorting (Mallory Type 3222J)*
*S3—S.p.s.t. toggle switch*
*T1—Audio output transformer; primary, 10,000 ohms, secondary 4 ohms (Stancor A-3879 or equivalent)*
*T2—Power transformer; primary, 117 volts; secondaries, 460 volts CT @ 50 ma., 6.3 volts @ 2.5 amp (Thordarson 24R11-U)*
*V1, V2—6CX8 vacuum tube*
*V3—6X4 vacuum tube*
*X1—8.+mc. transmitting crystal*
*1—4½" x 6" x 8" aluminum utility box (LMB 146 or equivalent)*
*1—4½" x 8" aluminum plate for chassis shelf*
*2—9-pin miniature tube socket*
*1—7-pin miniature tube socket*
*1—Xtal socket for FT-243 crystal holders*
*Misc.—Aluminum angle stock, terminal strips, RG-58/U cable, shielded audio cable, hookup wire, hardware, solder lugs, grommets, etc.*

made, change the crystal for a more active one. Set the transmit switch to standby position and move the meter switch to indicate plate current. Rotate the antenna tuning control to the maximum counterclockwise position (full capacity) and depress the transmit switch. Tune the plate for maximum current dip, then adjust the antenna and plate controls alternately until the current is 22 ma. The last adjustment should be made with the plate tuning control. At this point, the transmitter is fully loaded.

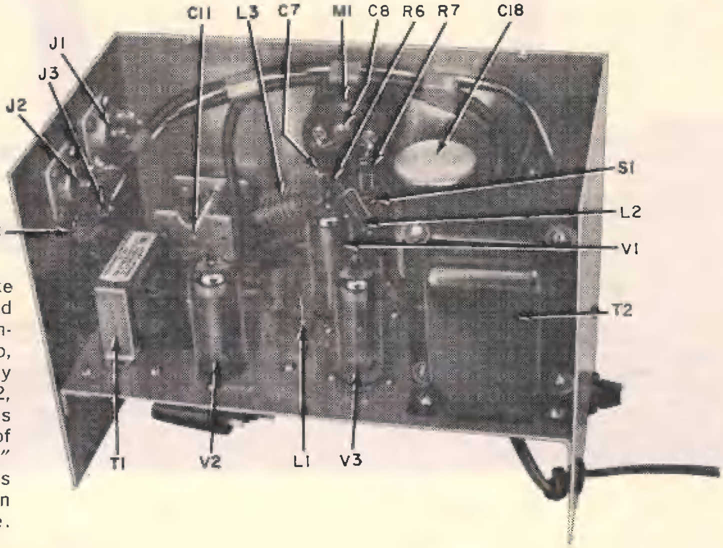
Check the grid current again, and reset *L1* if necessary for a 2-ma. reading. These tune-up procedures should also be used for on-the-air operation with an antenna connected in place of the dummy load.

Your receiver can be used to check modulation with a high-output crystal mike connected to *J4*. The radiation from the dummy load should be sufficient for this test. In the interests of economy and simplicity, the speech amplifier-modulator of the Companion




The dimensions above show approximate component spacing.



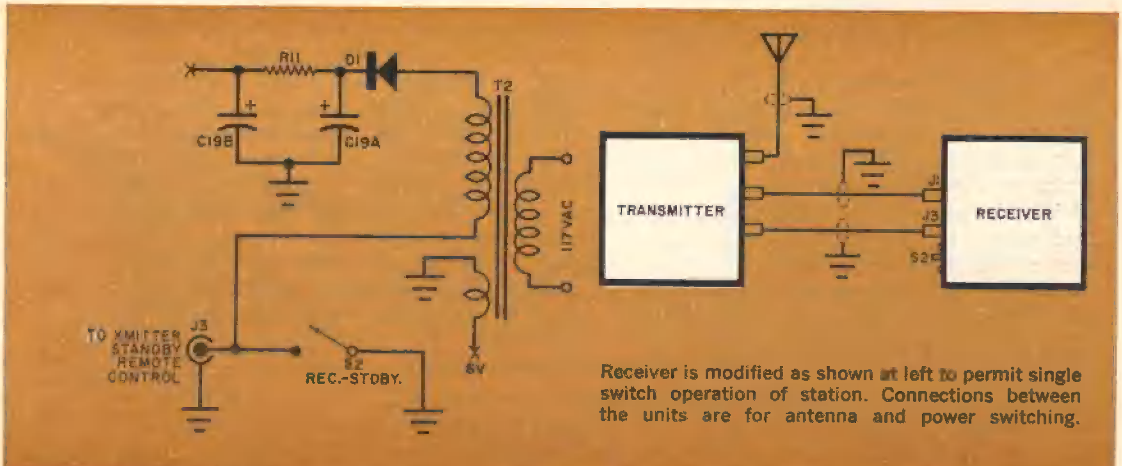

Top of rig looks like this, with M1 mounted at center of front panel and ½" from top, S1 and C10 directly below it. Switch S2, hidden behind T2, is mounted in middle of panel and about 1¼" in from side; C11 is similarly mounted on the opposite side.

Transmitter was limited to a single tube. For this reason, a high-output mike must be used for a good percentage of modulation. Strongly recommended is the Astatic Model 150 recorder mike which has an output of −44 db. It is readily available and sells for under $4.00.

**"Simple Superhet" Conversion.** If you plan to use the "Simple Superhet for 6" as the station receiver, a few simple modifications will give you improved reception and single-switch operation.

A remote control jack and standby switch (*J3* and *S2* in the drawing below) are installed on the side of the receiver cabinet. The ground lead of the receiver transformer is then connected as shown. This arrangement permits transmitter switch *S2* to control the receiver. More B-plus for the receiver can be obtained by replacing the selenium rectifier (see the April, 1963, issue) with a 400-PIV, 450-ma. silicon unit.

The most-used portion of the 6-meter band, 50-51 mc., can be made to cover more of the receiver dial by connecting a 10-pf., 600-volt ceramic tubular capacitor between the stators of *C1* and *C2*. Readjust the bandset capacitor *C2* and calibrate the receiver as described in the original article. –30–




Receiver is modified as shown at left to permit single switch operation of station. Connections between the units are for antenna and power switching.

# TUNE IN ON AIR

***"Wun sev-en nin-er, clear to land on runway eighteen."***

***Eavesdropping makes you the easy-chair copilot***

IF YOU HAVEN'T as yet given ear to the short-wave activity around your local airport, you've got a thrill in store. It doesn't matter whether a plane is a one-passenger, single-engine, Sunday-flying private job, or a huge multi-engine transport—nearly all planes are directed by radio. On bright Sunday afternoons, many private planes are taken up for an airing in addition to the regularly scheduled commercial planes, and if you listen in then you will understand why the control tower is sometimes called the "madhouse."

While eavesdropping on aircraft was once a very expensive proposition, many suitable "average priced" receivers are now commercially available which cover the frequencies used by the airlines and private planes. You'll need a unit that can tune from about 118 to 135 mc., and a simple antenna. Most of the available receivers have a wider range, about 108-135 mc. Some of the reasonably priced units you can get are the Hallicrafters CRX-3 ($94.94), the Regency AR-132 ($59.95) and "Flight Monitoradio" ($79.95), and the Nova-Tech "3-Bander" ($69.95).

**What You'll Hear.** The lower portion of the 108-135 mc. band is used for navigation aids (called "navaids") such as instrument landing systems, and VHF Omnirange Radio (VOR). Once you've heard these automatic transmitters, however, you probably won't bother to listen to them again, for while they are interesting the first time, the automatically and constantly repeated signals do not lend themselves well to armchair flying.

In addition to the pilots and the tower

Tower operator (far left) directs landing aircraft. In "en route" radar room (directly at left) planes are followed by radar and flight records kept.

# TRAFFIC

**By MARSHALL LINCOLN**

operator, you can hear the taxi controller who is in charge of directing the aircraft on the ground just prior to takeoff or after landing. You can also hear the "en route" controller who observes aircraft in his assigned sector on a radar screen and gives the pilots instructions on what direction and altitude to fly to avoid conflict with other flights.

**Airport Jargon.** Some of the language you may hear will be confusing, so here are some definitions to help clear up the terms:

*Wind direction* is given in compass degrees and *wind speed* is given in knots on the aircraft frequencies. When a control tower operator says "wind 180 at 15," he means that the wind is from the south (180°) at 15 knots (15 nautical miles per hour).

Typical receiver for monitoring aviation radio signals as a hobby is the Regency "Flight Monitoradio."

*Runways* are designated according to the compass direction an aircraft is flying when it lands, with the last digit of the compass heading omitted. When a control tower operator says a certain plane is "clear to land runway 22," he means that the plane has approval to land on the runway heading in a direction of 220° (southwest). The same runway, approached from the opposite end, would be called "runway 4" (head-

(*Continued on page* 116)

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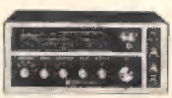

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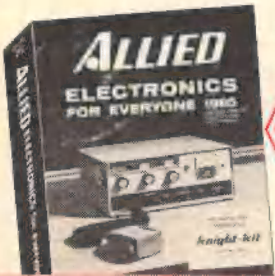


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**Knight-Kit KG-375 Universal Auto Analyzer Kit**—great for tune-ups—checks generator, alternator, regulator, wiring, both 6 and 12-volt, all engines. Big 7" meter; self-powered. Outstanding kit buy!

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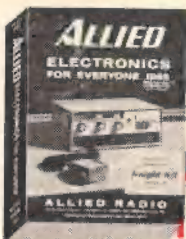


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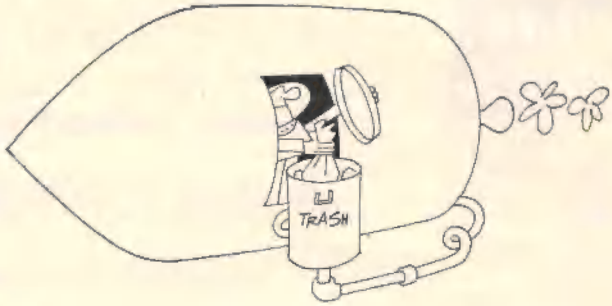
CIRCLE NO. 1 ON READER SERVICE PAGE

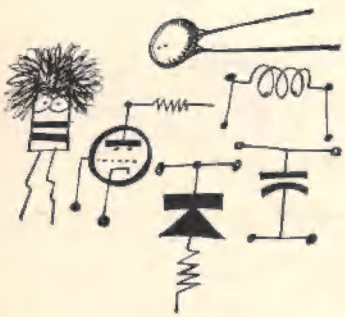
# Hobnobbing with Harbaugh




With the help of the biocell, space ships will generate electric power through the use of their own waste material.

## *Biocells—Revisited*

Biocells are hungry little devils. Here is a flashlight with fuel to run it for a week (20,000 calories).



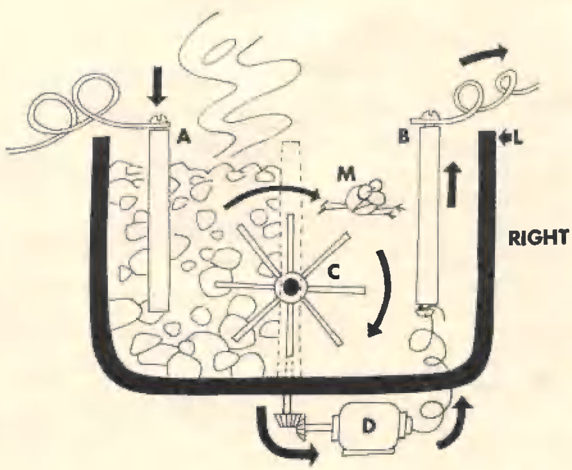
Here are a few mutations of common electronic components after attachment to a biocell.

As the bacteria in biocells become more sophisticated, they may eventually begin to look like this.

**HOW THE BIOCELL OPERATES**

1. Fill left side of container with either sewage or garbage.
2. Feed hydrogen to electrode "A."
3. Hydrogen molecule "M" is unable to stand smell and rushes to oxygen electrode "B."
4. Movement of molecule "M" causes ion exchange paddle wheel "C" to revolve.
5. Paddle wheel is gear connected to electric generator "D" and the output wired to oxygen electrode "B."

Note: For best results, fill to level "L."



# Monthly Short-Wave Report

By **HANK BENNETT**, W2PNA/WPE2FT
Short-Wave Editor

### WHEN IS A VERIFICATION NOT A VERIFICATION?

IF YOU receive a QSL-type card from a short-wave station with nothing whatever on it to indicate that the station is, in fact, verifying your report, do you consider it a bona fide verification? For several years now there has been what would appear to be a rather haphazard or "who cares?" type of attitude on the part of a number of stations with regard to their verification policies.

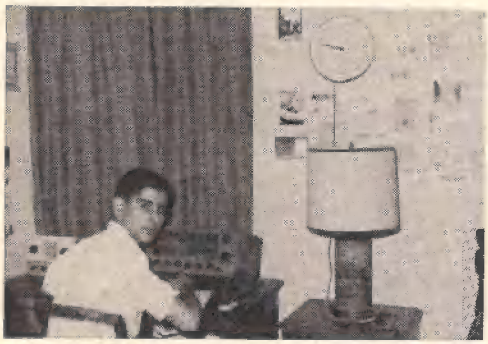
Basically, in order for a verification to be properly called a verification, it should include, as a bare minimum, the frequency, date, and time of the broadcast being verified, and this information should be clearly written or typed. Do all of *your* QSL's contain all of these items? We'll bet not.

Within the past few years the popularity of short-wave listening has increased tremendously. More people than ever before are literally bombarding stations the world over with reception reports. Many stations say that hundreds of these reception reports are of little or no value for they are carelessly prepared and include nothing which might be of use to a station's engineering department. On the other hand, a great many reports are carefully prepared, intelligently written up, and do contain useful information on receiving conditions.

To answer all of this mail requires time and effort by somebody. There are probably some stations that need a whole department just to answer mail and send out verifications. It goes without saying that most broadcasting organizations must expedite this work to the greatest degree possible in order to save time and personnel expenses. No one can disagree with that. But we can, and do, disagree with the types of QSL's that are sent out in some cases.

We respectfully suggest that the short-wave stations take a hard look at their verifying policies. Are those incoming reports really checked? Does each verification have the frequency, date, and time of the broadcast clearly indicated on it? There is little point in an SWL trying to convince himself that he actually has a QSL if, in fact, he has only a postcard containing the name and address of a station.

We have no doubt that many of the stations would like to take issue with us on this subject. Perhaps the stations could come up with some good constructive criticism on in-



Edward Jacobson, WPE2JEL, Westbury, N.Y., uses a Lafayette HE-30 receiver, with a Lafayette KT-135 in standby service. He has two antennas: a 70′ long-wire and Hy-Gain 40′ short-wave dipole. Ed's record to date: 84 countries logged, 36 verifications.

Roger Bowman, WPE4ESK (below), of Winter Park, Fla., has 52 countries logged with 35 confirmed. He DX'es with a Knight R-100A receiver, a Holstrom SK-20 preselector, and a 60′ long-wire antenna.

coming reports from SWL's in an effort to do away with the "I heard you, please QSL" type of report, and thus gain more time to give bona fide veries on the properly prepared and useful reports. We would welcome responsible comments from any station.

**Special "States" Award.** One of the most unusual DX Award applications that we have received to date came in from Arno Feltner, of New Braunfels, Texas, who has qualified for the "30 States Verified" award. Every station Arno listed was in the Citizens Band service! Further, out of the 30 stations listed, 28 were logged and verified on *one* frequency—27,155 kc. The other two stations were heard on 27,275 kc. and 27,105 kc.

**Long-Wave Reception.** Your Short-Wave Editor has recently been experimenting with a National HRO-50T1 receiver utilizing long-wave coils from an HRO-60 in an effort to log some of the European long-wave broadcasters. To date the results have been something less than satisfactory due mainly to the use of an improper antenna for this frequency range. However, we have noted an excellent source of code practice material for those of you who may be interested. If you can tune to 125 kc., look for NSS; it broadcasts almost continual press reports, news items, and sports results. Incidentally, reports from SWL's who can tune the 50-200 kc. range will be appreciated.

(*Continued on page* 111)

## ENGLISH-LANGUAGE NEWSCASTS TO NORTH AMERICA

*All of the stations below specifically beam English-language newscasts to the U.S.A. The times may vary a few minutes from day to day.*

| COUNTRY | STATION | FREQUENCY *(kc.)* | TIMES *(EST)* |
|---|---|---|---|
| Argentina | Buenos Aires | 11,780, 9690, 6090 | 2200, 0100 (Mon.-Fri.) |
| Australia | Melbourne | 17,840, 15,220 | 2030, 2130, 2230 |
| | | 9580 | 0745 |
| Bulgaria | Sofia | 6070 (and/or 9700) | 1900, 2000, 2300 |
| | | 7290 | 1630 |
| Canada | Montreal | 15,190, 11,760, 9585 | 1800 (Caribbean) |
| | | 9625, 5970 | 0215, 0300 (W. Coast) |
| Congo (East) | Leopoldville | 11,755 | 1630, 2100, 2230 |
| Congo (West) | Brazzaville | 15,190 | 1430 |
| Czechoslovakia | Prague | 11,990, 9795, 9550, 7345 (also 15,285 at 2030; 11,990 at 2230) | 2030, 2230 |
| Denmark | Copenhagen | 15,165 | 0700 |
| | | 9520 | 2100 |
| Finland | Helsinki | 15,185 | 1530 (Mon.-Fri.) |
| West Germany | Cologne | 11,945, 11,795, 9735 | 1010 |
| | | 9640, 6075 | 2035 |
| | | 9735, 9575, 6145, 6075 | 0000 |
| Hungary | Budapest | 11,905, 9833, 7215 | 1930 |
| | | 9833, 7215, 6234 | 2030, 2200, 2330 |
| Italy | Rome | 9575, 5960 | 1930, 2205 |
| Japan | Tokyo | 15,285, 15,135, 11,780 | 1900 |
| Lebanon | Beirut | 9625 | 2130 |
| Netherlands | Hilversum | 17,810, 15,445 | 1030 (Tues., Fri.) |
| | | 11,950, 9590 | 1415 (Tues., Fri.) |
| | | 7125, 6085 | 1630 (exc. Sun.) |
| | | 6035, 5985 | 2030 (exc. Sun.) |
| Portugal | Lisbon | 6185, 6025 | 2105, 2245 |
| Rumania | Bucharest | 11,810, 9510, 7225, 7195, 6190, 5990 | 1730 |
| Spain | Madrid | 9360, 6130 | 2215, 2315, 0015 |
| Sweden | Stockholm | 15,240 | 0900 |
| | | 9660 | 2215 |
| | | 5990 | 2045 |
| Switzerland | Berne | 11,865, 9655, 9535 | 2015, 2315 |
| | | 15,315 | 0950 |
| U.S.S.R. | Moscow | 9740, 9730, 9700, 9680, 9650, 9620, 9610, 9570, 7320, 7310, 7240, 7200, 7150 (may not all be in use at any one time) | 1730, 1900, 2000, 2100, 2300, 0040 |
| Vatican City | Vatican City | 9645, 7250, 6145 | 1950 |

# SPOOKIN' LIGHT

***Bizarre and eerie lighting effects are achieved by modulating an SCR light dimmer at an audio rate***

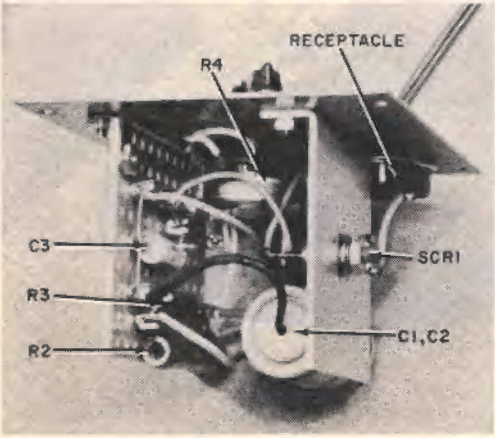
**By JEFF H. TAYLOR**

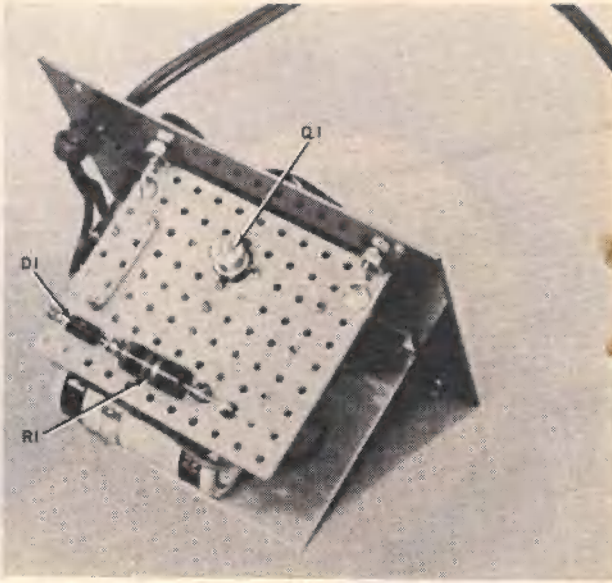
ARE YOU the type of electronics experimenter that gets a kick out of making Halloween exciting for the small "goblins" infesting your neighborhood? If so, this project is a *must build* for October 31.

Once the parts have been collected, you can probably build the "Spookin' Light" in one evening. Plug a porch light, carriage post lamp, or other outside lamp into this device, and when the supernatural Halloween phenomena start to flit through the air you will be in keeping with the atmosphere.

Underchassis view of the mounting board shows major parts placement.

View from side (below) locates the balance of the components.




The "Spookin' Light" flickers bright; dies away; flickers some more, and seemingly dances without rhyme or reason. You can also use this light controller for Christmas displays, especially if you are setting up a scene requiring electronic candles.*

The "Spookin' Light" is a modified light dimmer employing a silicon-controlled rectifier. The user can preset the dimming action via a built-in relaxation oscillator. The oscillator determines both the rate and brightness of the lamp load.

**The Circuit.** To operate the relaxation oscillator, a simple half-wave rectifier consisting of *C1*, *C2*, *D1*, *R1*, and *R2* delivers about 15 volts across *R3*. The oscillator part of the circuit is comprised of *C3*, *Q1*, *R4*, *R5*, *R6*, and *R7*. By adjusting potentiometer *R4*, the builder can vary the charging rate of capacitor *C3* from about 10 cycles to 100 cycles. As the charge on *C3* increases, the unijunction transistor (*Q1*) does not conduct; however, at the critical point, the emitter conducts very heavily, and a short pulse appears across *R7* in the *B1* leg of the unijunction. When *C3* discharges, *Q1* turns itself off and the process is repeated according to the rate set by *C3*.

Alternating current is applied to the anode of the silicon-controlled rectifier through the incandescent lamp. If there is no positive pulse applied to the gate of *SCR1*, there will be insufficient current passage to permit the lamp to glow. When a positive pulse appears at *R7* (hence the gate), and simultaneously a positive half-cycle of a.c. is applied to the anode, the SCR will conduct and the lamp will glow. The brilliance of the lamp is determined haphazardly by the coincidence between the positive pulse from the relaxation oscillator and the a.c. cycling through the incandescent lamp load.

If the oscillator is adjusted to the 60-cycle line frequency, the lamp may or may not light—depending on the portion of the a.c. cycle where the oscillator pulses appear. As the oscillator frequency (determined by the setting of *R4*) goes off the line current frequency, the lamp will glow slowly on and off, indicating that there is a "beat frequency" being generated. Thus, the lamp is really glowing at two separate and distinct rates. On one hand it is glowing at the rate determined by the relaxation oscillator, and on the other hand it is glowing at a beat frequency between the oscillator and a.c. line frequency.

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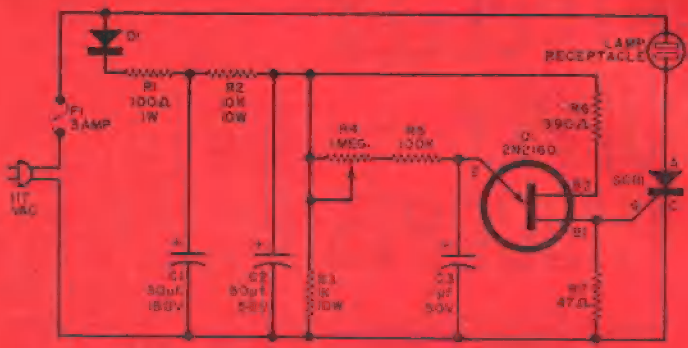
**The author's electronic candle project is scheduled for publication in November. Its circuitry is similar to that of the "Spookin' Light" but the flickering is more pronounced and rhythmic.*




When wiring the unit, be sure that no parts come in contact with chassis.

Finished unit (below) is ready to go and spook all goblins that visit you.

## PARTS LIST

*C1—30-µf., 150-volt electrolytic capacitor (see C2)*
*C2—50-µf., 50-volt electrolytic capacitor (C1 and C2 are in same case—Mallory TCD-497)*
*C3—0.1-µf., 50-volt molded capacitor*
*D1—200-volt PIV, 750-ma. silicon diode (1N2069 or equivalent)*
*F1—3-amp fuse*
*Q1—2N2160 unijunction transistor*
*R1—100-ohm, 1-watt resistor*
*R2—10,000-ohm, 10-watt resistor*
*R3—1000-ohm, 10-watt resistor*
*R4—1.0-megohm potentiometer*
*R5—100,000-ohm, ½-watt resistor*
*R6—390-ohm, ½-watt resistor*
*R7—47-ohm, ½-watt resistor*
*SCR1—Silicon-controlled rectifier, 200-volt peak reverse voltage, 4.0-6.0 average forward current (author used Texas Instruments 40A2; General Electric X1 can be substituted)*
*Misc.—Aluminum utility box, Vectorbord, angle brackets, sheet aluminum, transistor socket, push-in terminals, a.c. chassis receptacle, fuse holder, etc.*

**Construction.** A prerequisite in building your "Spookin' Light" is to be absolutely sure that none of the components is in electrical contact with the aluminum box. A 1:1 isolation transformer would make this device safer, but if reasonable care is exercised in construction, the "Spookin' Light" will not present a shock hazard.

The model shown was built in a commonly available 3" x 5" x 4" aluminum utility box. Attached to one of the removable sides is the heat sink for the SCR and a Vectorbord shelf holding many of the other components. The heat sink was cut from a moderately heavy piece of scrap aluminum measuring 2½" x 3". Bend a ½" strip of the 3" length to make an angle bracket to bolt the sink to the removable box side. Drill the necessary diameter hole for the SCR and carefully mount the SCR so that it is electrically insulated from the heat sink.

A 2½" x 3" piece of perforated Vectorbord is attached to the removable side with two small angle brackets. Push-in terminals are used to hold components *C3*, *D1*, *R1*, *R2*, *R3*, *R5*, *R6*, and *R7* in place. Transistor *Q1* is socket-mounted with the socket force-fitted in an appropriate size hole in the Vectorbord. Capacitors *C1* and *C2* are in the same housing, which is attached to the heat sink by means of a retaining band.

Potentiometer *R4*, fuse *F1*, and the lamp receptacle are mounted on the removable side. The overall fit is compact, but still leaves enough room for incidental soldering and circuit checking.

**Operation.** Since the incandescent lamp is operating on half-wave a.c., it is desirable to use a larger wattage bulb than normal to achieve useful effects—100 watts instead of 60 watts, 150 watts instead of 75, etc. A 300-watt photoflood bulb is another good choice. The "Spookin' Light" will handle bulbs normally drawing up to 450 watts. —30—

# LIGHT-CONTROLLED POWER SUPPLY---SECOND THOUGHTS

## Advanced Experimenter's Corner

By **BRIAN C. SNOW**

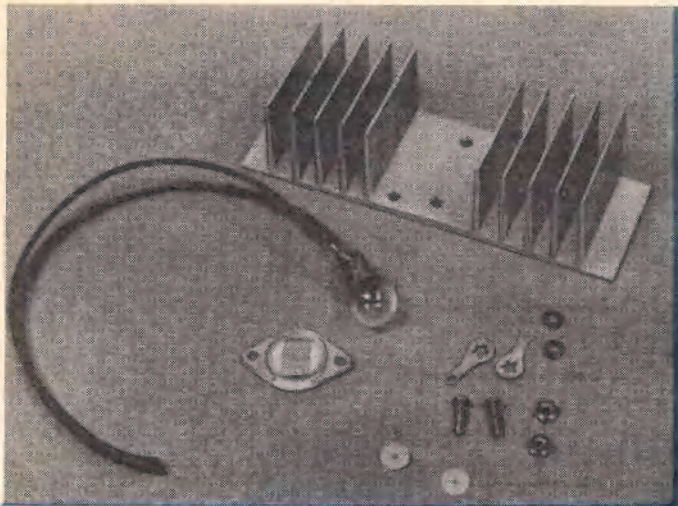
EDITOR'S NOTE: Several score circuit adaptations were received in response to the "open-ended" project published on page 53 of our February, 1964, issue. That project, entitled "Light-Controlled Power Supply," introduced the Delco LDR-25 heavy-duty photocell as a means of controlling the output of a low-voltage power supply. In publishing it, the Editors indicated that they felt refinements were possible. The article on these pages represents the best of the many adaptations and improvements designed by our readers.

***Improved bench supply for transistor experiments featuring either constant current or constant voltage***

THIS INEXPENSIVE regulated low-voltage power supply is a handy piece of equipment for anyone experimenting with transistors. One version provides up to an ampere at a continuously variable regulated voltage of 0-25 volts d.c. A second version will produce a constant current of up to 1 ampere at any voltage up to 30 volts. In both circuits, the output is controlled by a heavy-duty photocell acting as a light-controlled variable resistor in series with the primary of the power transformer.

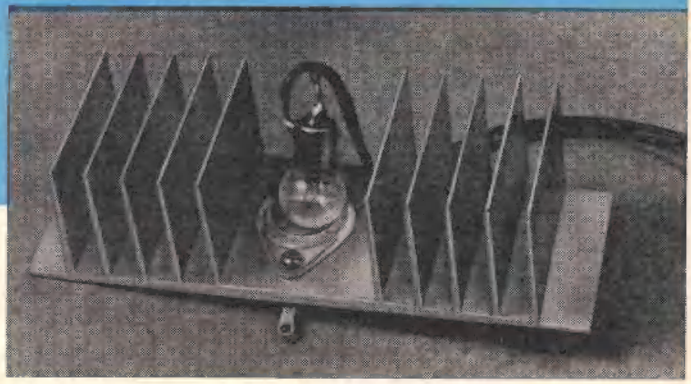
**Constant Voltage Circuit.** The reader will note that the circuit actually consists of three distinct power supplies. The principal supply is a conventional full-wave bridge, the output of which is controlled by the load and the resistance of photocell *PC1*. Supplied by transformer *T2* are the reference voltage supply (*C2, D6, D7, R2,* and *R3*) and the supply (*D5* and *C3*) for the direct-coupled error amplifier.

The output voltage is determined by the setting of control potentiometer *R7*. This potentiometer is one leg of a bridge formed by the load, reference resistor *R3,* and reference zener diode *D7*. Once *R7* has been set, any change in the load will unbalance the bridge and apply an "error" signal between *R4* and *R6* to the



Parts mounted on heat sink are shown disassembled at left. Note that no socket is used; wires connect to lamp.

Assembled heat sink is shown below, before encapsulation and painting.



error amplifier (*Q1* and *Q2*). A 12-volt bulb in the collector lead of *Q2* is close-coupled to photocell *PC1*, and since the intensity of the bulb determines the resistance of *PC1*, the output voltage is brought back into balance.

There is some thermal inertia in control lamp *I1*, so the supply reaction is not instantaneous. However, for experimental bench work, this power supply is more than adequate.

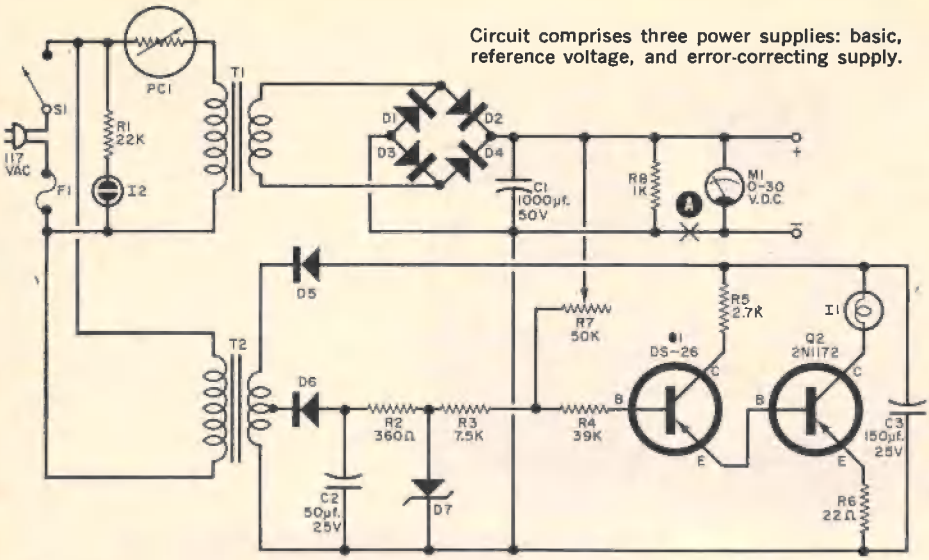
**Construction.** With the exception of the mounting of *I1* and *PC1*, the construction of this supply can be left entirely to whims of the builder. The photographs show the model constructed by the author in a Bud Radio AC-1613 sloping-panel cabinet.

Bulb *I1* and photocell *PC1* must be shielded from external light. Since *PC1* must be mounted on a heat sink, the author took advantage of this fact to place bulb *I1* in contact with *PC1*, sealing off external light by encapsulating both components in "Castolite."

Before mounting the photocell, drill two 5/32" holes on 1" centers, plus another hole ½" to one side to pass the leads from the bulb. Coat the underside of *PC1* with silicon grease for good thermal contact and mount the photocell with two *4-40* x ½" round-head bolts and nuts. Don't forget the nylon washer to insulate *PC1* from the heat sink.

Block off the two open sides of the heat sink with pieces of scrap aluminum and fill in the boxed area with an epoxy such as Castolite. After allowing the proper curing time, paint the encapsulated area with several coats of black paint to prohibit incident light from affecting the photocell.

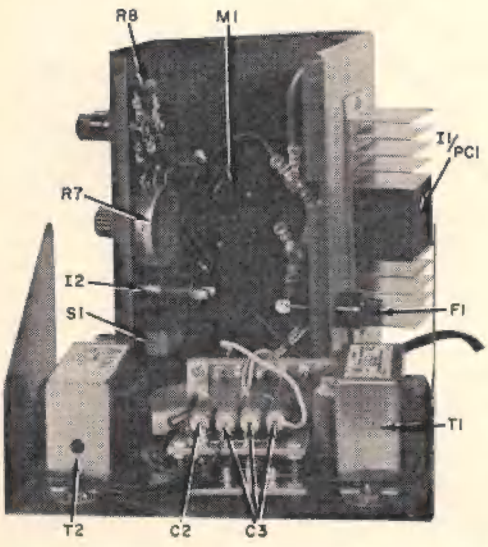
**Modifying for Constant Current.** The basic circuit can be changed to effect a constant current output of up to 1.0 ampere. This is done by increasing the value




Circuit comprises three power supplies: basic, reference voltage, and error-correcting supply.

**PARTS LIST**

*C1—1000-µf., 50-volt electrolytic capacitor (author used two 500-µf. units in parallel)*
*C2—50-µf., 25-volt electrolytic capacitor*
*C3—150-µf., 25-volt electrolytic capacitor (author used three 50-µf. units in parallel)*
*D1-D6—1.5-amp, 100-PIV silicon diode*
*D7—1N1766 6.2-volt zener diode*
*F1—¼-amp type 3AG fast-action fuse*
*I1—12-volt lamp (GE #57)*
*I2—NE-51 neon lamp*
*M1—0-30 voltmeter (Weston 301-57, if used)*
*PC1—Photocell (Delco LDR-25)*
*Q1—Pnp transistor (Delco DS-26)*
*Q2—Pnp transistor (Delco 2N1172)*
*R1—22,000-ohm, ½-watt resistor*
*R2—360-ohm, ½-watt resistor*
*R3—7500-ohm, ½-watt resistor*
*R4—39,000-ohm, ½-watt resistor*
*R5—2700-ohm, ½-watt resistor*
*R6—22-ohm, ½-watt resistor*
*R7—50,000-ohm, 2-watt potentiometer*
*R8—1000-ohm, 2-watt resistor*
*S1—S.p.s.t. toggle switch*
*T1—Filament transformer: primary, 117 volts; secondary, 25.2 volts, 1 amp (Stancor P-6469)*
*T2—Filament transformer; primary, 117 volts; secondary, 12.6 volts, CT, 2 amp (Stancor P-8130)*
*1—Sloping panel box (Bud AC-1613)*
*1—Heat sink (Delco 7278482)*
*Misc.—Line cord, neon lamp socket, binding posts, fuse holder, terminal boards, knob, hardware, hookup wire, etc.*

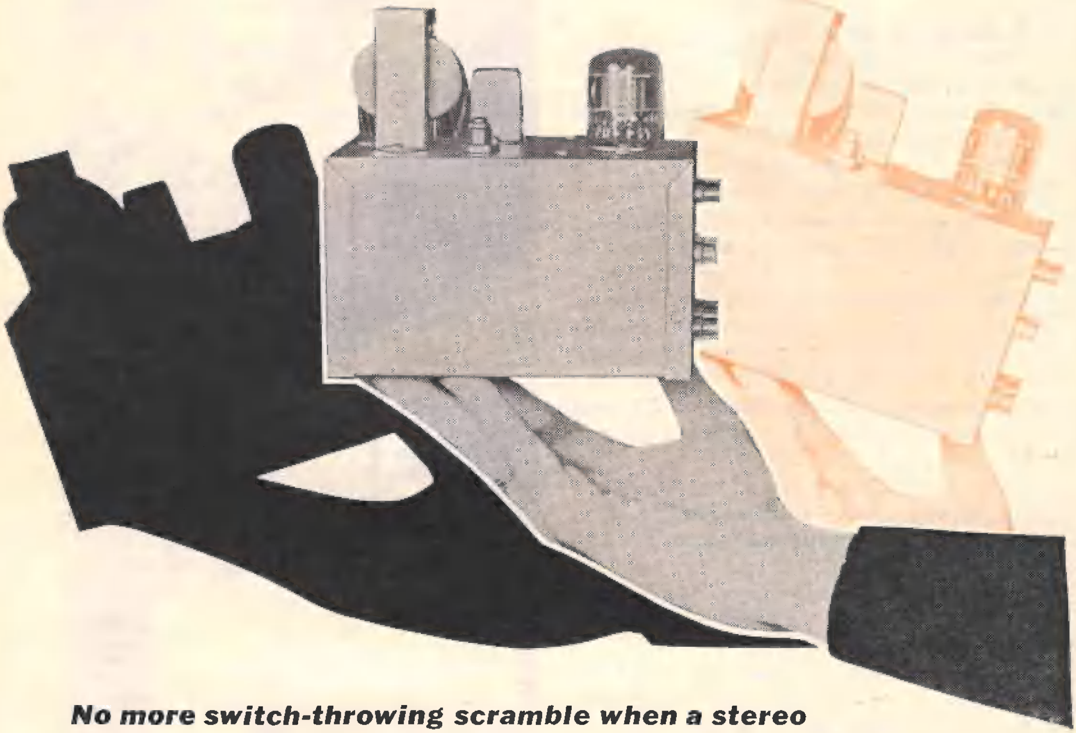



of *R3* from 7500 ohms to 12,000 ohms; inserting a 5-ohm, 5-watt resistor at point *A* in the diagram; and changing the value of *R7* from 50,000 ohms down to 10,000 ohms while simultaneously shifting the wiper arm connection of *R7* to the "minus" output terminal.

You can eliminate voltmeter *M1* if you wish, and substitute a 0-1.0 amp meter in the positive output lead.

Operation is essentially similar to that of the constant voltage supply. In the constant current supply, the voltage drop across the new 5-ohm resistor is one leg of the "error" bridge. The bridge is unbalanced when the voltage across the 5-ohm resistor divided by potentiometer *R7* (now 10,000 ohms) is not equal to the reference voltage divided by *R3* (now 7500 ohms). —30—

# THE
# Stereo S'Lector



***No more switch-throwing scramble when a stereo station comes in! The S'Lector does it for you***

**By ALTON B. OTIS, JR.**

IF you have a mono FM tuner and an outboard multiplex adapter, the "Stereo S'Lector" is for you! In addition to giving you a visual indication that a stereocast is coming through, it will automatically switch the multiplex adapter into the circuit and connect the adapter's output to the stereo tuner terminals of the amplifier—a feature found only in the more expensive commercial FM stereo tuners. The cost of the parts required to build the S'Lector is nominal—only about $15.00.

**How it Works.** The single compactron tube, *V1*, is a 6D10 which has three separate triodes in one envelope. The multiplex signal from the tuner is applied to *V1a*, which is a low-gain amplifier with a high input impedance. From there, it goes to a variable-mu, high-gain amplifier, *V1b*. The output of *V1b* is fed to a filter consisting of *L1* and *C5*. This removes all but the 19-kc. components of the signal.

The 19-kc. signal is rectified by diode *D1* and the resulting d.c. voltage is applied to the grid of relay control *V1c*. When no 19-kc. signal is present (as in a monophonic signal), the relay remains pulled in, connecting the normal output of the tuner to the amplifier. A 19-kc. signal will apply a negative voltage to the grid of *V1c*, which causes the relay to open, connecting the tuner stereo out-

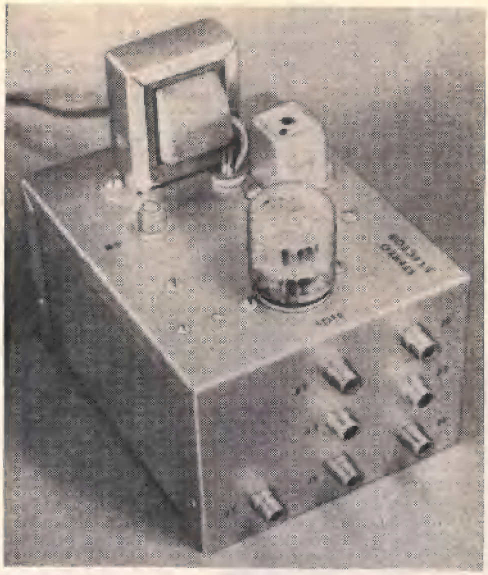
put to the amplifier, and simultaneously turning on the stereo indicator lamp (*I1*).

**Building the Unit.** The Stereo S'Lector is constructed in a 3" x 4" x 5" aluminum Minibox. Parts layout is not critical, but the photos show the layout used satisfactorily by the author.

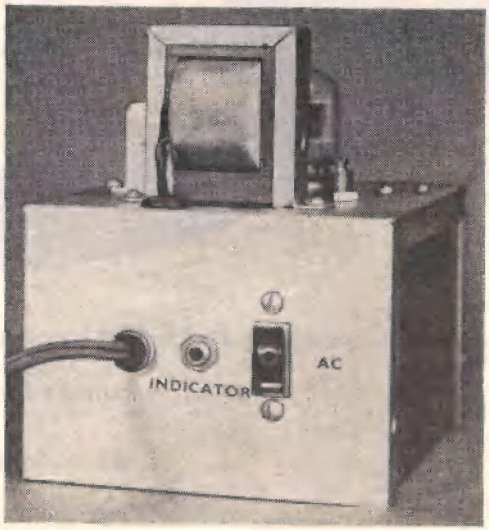
Coil *L1* is mounted by means of a flange provided with the coil. Power rectifier *D2* is mounted on a three-lug (center ground) terminal strip which is attached under one of the power transformer mounting screws. A single solder lug under the other transformer mounting screw serves as a ground for capacitors *C6* and *C7*. Capacitor *C5* mounts directly across the terminals of *L1*, and *D1* is connected directly between *L1* and *R9*.

Two of the four poles of relay *K1* are used for switching the output between the tuner and multiplex adapter. The other two relay poles can be used to trigger external indicators (as shown here) or for other signaling or switching functions.

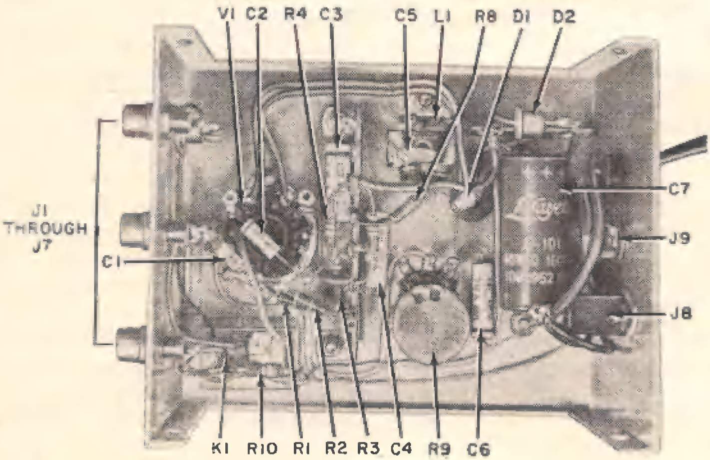
**Tuning Up.** Check the unit carefully for short circuits, and remove all solder splashes and wire bits. Before installing the 6D10, plug the unit in; the voltage across capacitor *C7* should read about 200 volts. Install the tube and allow a short warm-up period. Voltage across *C7* should now read about 140-150 volts, d.c.



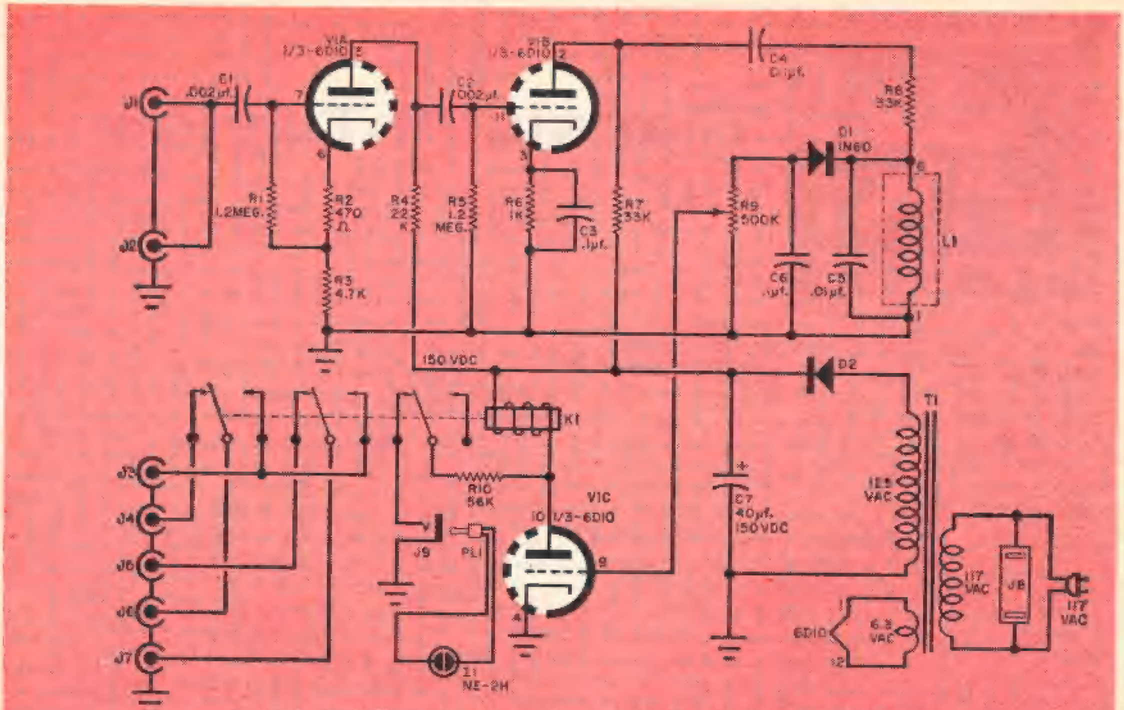
Finish the Stereo S'Lector with a coat of spray paint and press-on letters for jack identification.




Indicator lamp jack is connected to miniature plug so lamp can be mounted at tuner or amplifier panel.




Parts layout is not at all critical but author's model is detailed in photo at left with parts call-outs.




A single compactron tube does the work of three in the Stereo S'Lector circuit.

## PARTS LIST

*C1, C2—0.002-µf., 200-volt Mylar capacitor*
*C3, C4, C6—0.1-µf., 100-volt Mylar capacitor*
*C5—0.01-µf. ceramic disc capacitor*
*C7—40-µf., 150-volt electrolytic capacitor*
*D1—1N60 diode (or equivalent)*
*D2—50-ma., 400-PIV silicon rectifier*
*I1—NE-2H neon lamp*
*J1-J7—Phono jack (single-hole type)*
*J8—117-volt accessory outlet*
*J9—Miniature phone jack*
*K1—4-p.d.t. relay, 5300-ohm coil, 6.6-ma. pull-in (Lafayette F-333 or equivalent)*
*L1—19-kc. oscillator coil (J. W. Miller 1354)*
*PL1—Miniature phone plug*
*R1, R5—1.2-megohm, ½-watt resistor*
*R2—470-ohm, ½-watt resistor*
*R3—4700-ohm, ½-watt resistor*
*R4—22,000-ohm, ½-watt resistor*
*R6—1000-ohm, ½-watt resistor*
*R7, R8—33,000-ohm, ½-watt resistor*
*R9—500,000-ohm linear taper potentiometer*
*R10—56,000-ohm, ½-watt resistor*
*T1—Power transformer; primary, 117 volts; secondaries, 125 volts, 15 ma., and 6.3 volts, 0.6-amp. (Lafayette TR-121, Stancor PS-8415, or equivalent)*
*V1—6D10 compactron tube*
*1—3" x 4" x 5" aluminum Minibox*
*Misc.—12-pin compactron socket, terminal strips, wire, solder, line cord, etc.*

If it is substantially lower, pull the plug and inspect the unit again for shorts.

Connect the Stereo S'Lector to the tuner with jacks, as follows: *J1* to multiplex output of tuner; *J2* to input of multiplex adapter; *J3* to monophonic output of tuner; *J4* and *J5* to the stereo amplifier inputs; *J6* and *J7* to the output of the multiplex adapter.

With the tuner set to a strong stereo station, adjust the slug in *L1* for maximum a.c. voltage across the coil. The reading may fluctuate at this point, depending on the program material. Starting with the wiper of *R9* at the ground end, advance the wiper toward *D1* until the relay drops out, then about five or ten degrees more. The unit is now adjusted and ready for use.

The model built by the author has performed very reliably, never confusing interchannel noise and a stereo broadcast. If you build the S'Lector, you'll find it a valuable adjunct to your stereo system, one that you will wonder how you ever got along without. —30—

# Transistor Topics

By **LOU GARNER,** Semiconductor Editor

A NEW transistorized travel aid for the blind has been developed by the Radio and Electrical Engineering Division of the National Research Council, Ottawa, Canada. Unlike other types of blind aids designed to detect obstacles in the immediate path of the operator, this unit is intended to indicate overall direction of travel. Essentially a compact broadcast-band radio direction finder, its application is roughly analogous to a small boat's compass as contrasted to its short-range radar. Its operator can easily determine—with fair accuracy—the direction of known nearby stations and thus establish his general path of travel without reference to street corners, buildings or other physical objects. The device is especially valuable in open areas such as parks, or where several streets intersect at odd angles, making directions difficult to determine.

Although most small AM broadcast receivers can serve as radio direction finders because of the directional characteristics of their ferrite core antennas, their practical use in this application is limited by several factors. First, their a.g.c. systems, if effective, tend to broaden and mask the null points. Second, lulls in the transmitted program may be misinterpreted as false nulls. Finally, the music or speech itself may prove distracting to the user. The new aid overcomes these disadvantages by substituting a variable pitch audio tone for the program material.

Figure 1 is a block diagram of the instrument. The essential components are a highly directional loop antenna, an r.f. amplifier/converter stage, one or more i.f. stages, a detector, a blocking oscillator (or multivibrator), an audio amplifier and, finally, a power amplifier driving an earphone or small loudspeaker. Operating power is furnished by conventional batteries.

In operation, the blocking oscillator's frequency is controlled by the d.c. a.g.c. voltage which varies with the strength of the received station's carrier signal. The actual pitch of the audio tone serves to indicate the approximate *distance* to the station, while changes in pitch as the set (and antenna) is rotated permit the station *direction* to be determined. An experienced operator can distinguish directions with an accuracy of five degrees or less.

Although not commercially available as yet, this new instrument should be a real

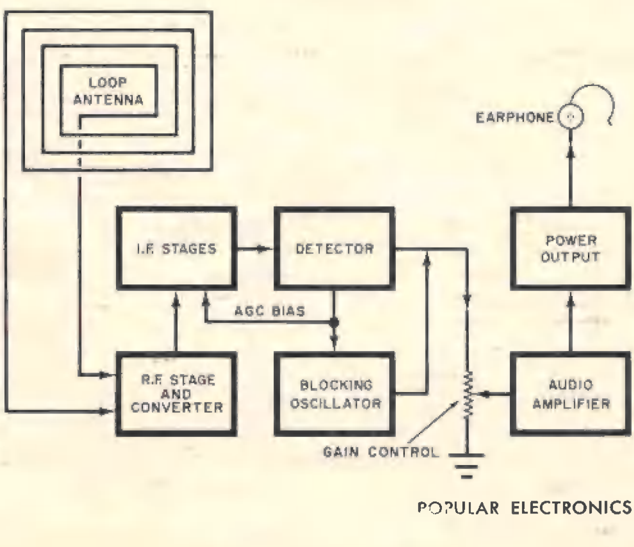



Fig. 1. Block diagram of the new transistorized travel aid for the blind developed by the National Research Council, Ottawa, Canada. Device is a broadcast-band radio direction finder which indicates overall direction of travel instead of detecting obstacles.

boon not only to blind persons but to hunters, fishermen, hikers, small boat owners, and others faced with the problem of locating their positions when away from known landmarks.

**Manufacturer's Circuit.** An easily built high-fidelity phonograph preamplifier circuit is illustrated in Fig. 2. This design, which is RIAA equalized, was developed by General Electric (Electronics Park, Syracuse, N.Y.) to demonstrate the use of their low-cost, epoxy-cased silicon transistors.

Referring to the schematic diagram, direct-coupled *npn* transistors are used throughout. Transistors *Q1* and *Q2* serve as high-gain common-emitter amplifiers while *Q3* is an impedance-matching emitter-follower. Designed for use with magnetic phono cartridges, the preamp can drive standard power amplifiers with moderate to high input impedances.

In operation, *R1* serves to adjust the circuit's input impedance and *C1* is an input coupling capacitor. The base bias of *Q1* is obtained from the voltage drop across *Q2*'s emitter resistor *R9*, bypassed by *C4*, and is furnished through *R2*. Emitter resistor *R4* serves both to stabilize *Q1*'s bias and to permit a frequency-compensating network between the first and second stages. This network, used to adjust the amplifier's response to match the RIAA equalization curve, is made up of *C2*, *R6*, *R5*, and *C3*.

Since direct-coupling is used between stages, each stage serves as a source of base bias for the following one. Thus, *Q2*'s base bias is furnished through *Q1*'s collector load (*R3*) and, similarly, *Q3*'s bias is supplied through *Q2*'s collector load (*R7*). Transistor *Q2*'s small unbypassed emitter resistor, *R8*, acts to stabilize second stage operation. The output stage, *Q3*, is used for isolation and as an impedance-matching device, with *Level* control *R10* serving as an emitter load and *C5* as an output coupling capacitor. Operating power is supplied by *B1*, controlled by *S1*.

Although standard components are used, a few circuit values are critical. Resistor *R2* should have a 5% tolerance, while *C2* and *C3* should be 10% tolerance types. All resistors except the *Level* control, *R10*, are half-watt units. Capacitors *C2* and *C3* can be mica, paper or ceramic types, while *C1*, *C4* and *C5* are electrolytic capacitors. Capacitor *C1* should be rated at 15 volts d.c., *C4* at 3 volts, and *C5* at 25 volts. The value of *C5* is not indicated, for the size needed will depend on the impedance of the load (power amplifier) with which the preamp is used; a small (1- or 2-μf.) unit will do if the load has a high impedance, but values up to 50 μf. may be required by moderate- or low-impedance loads to insure good low frequency response.

The transistors, as mentioned previously, are G.E.'s new epoxy-cased silicon types; *Q1* is a 2N2925, *Q2* a 2N2924 and *Q3* a 2N2926.

Any of several construction techniques can be employed. Depending on individual preferences, the preamp can be assembled either on a conventional metal chassis, a perforated phenolic base, or on an etched circuit board. Layout is not overly critical, but good wiring practice should be observed, with signal leads kept short and direct and ample separation provided between the input and output circuits.

A 22½-volt power supply (*B1*) is required. For intermittent operation, a small hearing aid battery (such as a Burgess U15) may be used, for the total current drain is only 3.5 ma. For continuous use, a heavier battery is necessary—a Burgess

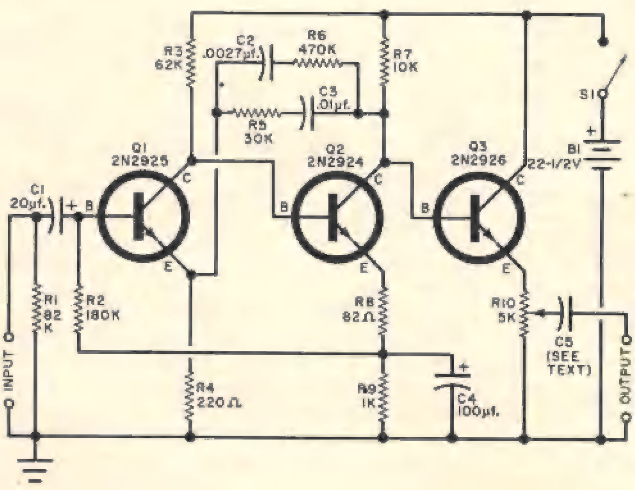



Fig. 2. Hi-fi phonograph preamplifier circuit developed by General Electric employs three of its low-cost epoxy-cased silicon units. Transistors Q1 and Q2 serve as high-gain common-emitter amplifiers and transistor Q3 as an impedance-matching emitter-follower.

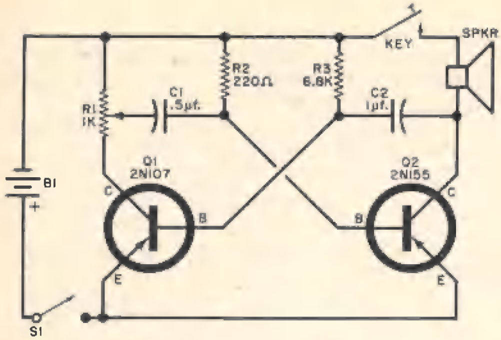


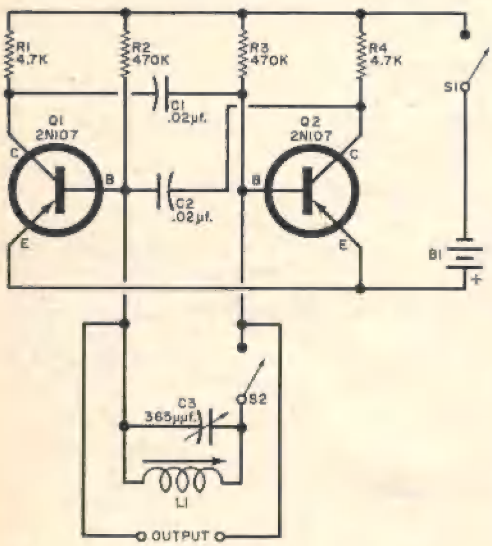

Fig. 3. Reader Mark Humphries put a multivibrator to work as a CPO. The pnp transistors are used in a modified collector-base-coupled arrangement.

XX15, for example. If preferred, a power pack can be made up by wiring 15 penlight cells in series.

Conventional shielded cable should be used for connecting the preamp to a phono cartridge and to the power amplifier. In addition, the entire preamp should be mounted in a shielded metal case (such as a small Minibox) to minimize hum and noise pickup.

**Readers' Circuits.** Multivibrators are extremely versatile circuits. As a result, many readers enjoy experimenting with different variations of the basic designs and in devising interesting applications for them. Two such circuits are presented here.

Fig. 4. Second multivibrator circuit, submitted by Robert Barlow, can be used either as audio or r.f. source for checking different types of equipment.




The *code practice oscillator* (CPO) circuit in Fig. 3 was submitted by reader Mark Humphries (553—31st St., Manhattan Beach, Calif. 90266). According to Mark, his circuit will deliver ample power for group practice.

Referring to the diagram, *pnp* transistors *Q1* and *Q2* are used in a modified collector-base-coupled arrangement, with *Q2*'s collector load a loudspeaker voice coil rather than a conventional resistor. The base bias for *Q1* is furnished through *R3* and the base bias for *Q2* through *R2*, while *C1* and *C2* serve as coupling capacitors. Operating power is supplied by *B1*, controlled by *S1*.

Readily available parts are used in the design. Transistor *Q1* is a general-purpose small-signal type, such as a 2N107, 2N109, CK722, etc., while *Q2* is a standard power transistor, such as a 2N155, 2N176, 2N255, or 2N301. Potentiometer *R1* is a small 1000-ohm unit, and *R2* and *R3* are half-watt resistors. Capacitor *C1* is a small paper type, *C2* a paper or 15-volt electrolytic type. Any small speaker with a 3.2- to 16-ohm voice coil can be used. Power switch *S1* can be a toggle, slide, or rotary s.p.s.t. unit. Finally, the power supply can be any standard battery (or combination of batteries) supplying from 3 to 12 volts; in general, the higher the supply voltage, the greater the output.

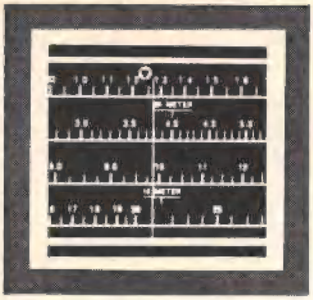
With neither layout nor wiring critical, Mark's CPO can be assembled on a small chassis, on an etched circuit board, or even, if preferred, breadboarded on a piece of perforated Masonite or a scrap piece of lumber.

An NRI student, Robert T. Barlow (940 Atwater Ave., Westmount, Quebec, Canada) submitted the multipurpose *signal generator* circuit in Fig. 4. Robert writes that his circuit can be used either as an audio or r.f. signal source for checking amplifiers, intercoms, record players or small receivers.

This circuit is also a modified collector-base-coupled arrangement using *pnp* transistors in the common-emitter configuration. The base bias for *Q1* is furnished through *R2*, the base bias for *Q2* through *R3*, while *R1* and *R4* serve as collector loads for *Q1* and *Q2*, respectively. The two stages are cross-coupled through *C1* and *C2*. A tuned r.f. circuit, *L1-C3*, can be switched into the circuit through *S2* to provide r.f. signals. Operating power is supplied by *B1*, controlled by *S1*.

Low-cost components are used. Transistors *Q1* and *Q2* are 2N107's or 2N109's, *C1* and *C2* are small ceramic capacitors, and all the resistors are half-watt units. The tuned circuit is made up of a broadcast-band "vari-loopstick" ferrite rod an-

(*Continued on page* 103)



# Across the Ham Bands

By **HERB S. BRIER** W9EGQ
Amateur Radio Editor

## THE AMATEUR SCENE: ALASKA AND WASHINGTON, D.C.

IN OUR April, 1964, column, we asked what you would do if you suddenly found yourself the only means of communication from your area as the result of some disaster. On March 27, as you probably know, hams in Alaska were asked that question in earnest when the first of a series of violent earthquakes and tidal waves struck the state. Most of the KL7 hams answered the question magnificently by handling the thousands of emergency and welfare messages that went in and out of Alaska during the following several days.

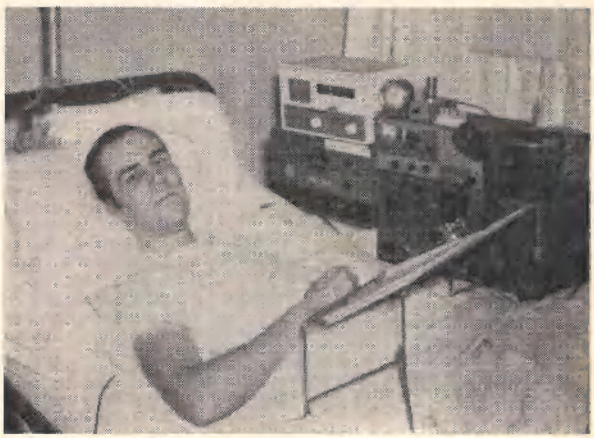
Of course, the KL7's could not have handled this traffic if there had not been other amateurs ready and waiting to accept and deliver the messages coming out of Alaska and to transmit the incoming ones. In addition to offering a hearty "Well done!" to all hams who provided emergency communications during the Alaskan disaster, we would like to add an extra commendation to the unsung hams who monitored the Alaskan stations for many hours, to be of service if needed, without making a single personal transmission. They contributed more to the success of the operation than the thoughtless hundreds who created so much needless interference by constantly breaking in with the question, "Do you have anything for . . . ?"

**Reciprocity Privileges.** The bill sponsored by Arizona's Senator Barry Goldwater, K7UGA/K3UIG, to permit licensed amateurs of the United States and other countries to operate in each other's country on a reciprocal basis, was signed into law by President Lyndon B. Johnson on May 28 after previously being passed by the U.S. Senate and House of Representatives. It is understood that the State Department will announce the signing of the necessary agreements with different countries as rapidly as possible.

The new law has been hailed as a tremendous step towards improved interna-

### *Amateur Station of the Month*

As the result of an automobile accident, Robert Isennock, KN3FJN, Forest Hill, Md., spent the last year encased in a three-quarter body cast. But time has whizzed by for him since he was introduced to ham radio. He worked 37 states in just two months, and has now passed his Conditional license exam. Bob receives a free one-year subscription for submitting the winning photo in our September contest. Starting this month, the Station of the Month contest will be open to all classes of amateurs. To enter, send in a picture of yourself at the controls of your station, along with some information about your equipment and operating achievements. Entries go to: Amateur Photo Contest, c/o Herb S. Brier, W9EGQ, Amateur Radio Editor, POPULAR ELECTRONICS, Box 678, Gary, Indiana.



After the amateur radio "bug" bit G. Suppan, Chicago, Ill., it took him just three months to go from a Novice to a General ticket. He is now WA9KTL.

tional understanding by prominent amateurs throughout the world.

**Free License Renewal Reminder.** The Foundation for Amateur Radio, Washington, D.C., is offering a unique license renewal reminder service to all amateurs. It works like this: You address a stamped postcard to yourself. At the top of the correspondence side of the card, when the card is turned horizontally, write the date (month and year only) that you want the card mailed back to you. Below the date, you can write any message you may wish to yourself, such as, "It is time to renew my license."

Then place the postcard in an envelope and mail it to Joan Machinchick, K3KBI, Lake Drive, Cape St. Clair, R.F.D., Annapolis, Md. 21401. When the month specified on the card rolls around, the card will be mailed back to you. The Foundation accepts no responsibility should the card not be mailed for some reason, but it agrees to maintain the service as long as volunteers are available.

The Knight-Kit T-60 transmitter and Lafayette KT-320 receiver owned by Mike Cleary, WNØGYU, Boonville, Mo., have ticked off 29 states and Canada.

**News for Certificate Hunters.** The Montgomery County (Illinois) AREC, Inc. is sponsoring a new "Prairie State Mother-Daughter Award." You earn the award by working four mother-daughter ham teams in three states. Each member of a team need not be in the same state—but the three states must be included in the eight contacts. There is no time limit. To receive the certificate, send a list of the eight contacts, including dates, calls, band, and signal reports signed by an officer of your radio club or by two other licensed amateurs with $1 to Mrs. Golde Hoover, K9AXS, 401 East Wood St., Hillsboro, Ill. (DX stations can qualify for this award with three teams—six contacts—in two states.)

C.L. Hardy, LU1DJU, QSL and Award Manager, Radio Club Argentino, Carlos Calvo 1420/24, Buenos Aires, Republica Argentina, reports that the Avenida Libertador, San Martin 1850 address published in several handbooks has been incorrect since 1956. As a result, many QSL cards and applications for awards sponsored by the Argentine radio club that were sent to the old address have been lost. Thanks to Carole, K9AMD, for this information.

## CLASSIC HAM CIRCUITS

Many amateurs believe that the single-sideband (SSB) mode of phone transmission was discovered after World War II and that its advantages of minimum bandwidth and high talk power assured its immediate success. These ideas are far from the truth. Transoceanic radiotelephone transmitters started using SSB in the middle 1920's. And several amateurs were successfully transmitting SSB signals before 1930!

These early amateur experimenters with SSB were far ahead of their time. Few amateur receivers of that day were capable of receiving SSB signals, and, in addition, the SSB transmitters were quite complicated for the results obtained. As a result, amateur SSB went into limbo for over 15 years.

**Complicated SSB Transmitters.** Even after SSB was rediscovered in the late 1940's, the SSB transmitter circuits appearing in the amateur press seemed so complicated that many amateurs predicted freely that the system would never become popular. Part of these doubts were due to prejudice and objection to change. Nevertheless, the

*(Continued on page 108)*

# Predicted Radio Receiving Conditions

***How the short-wave bands will sound in September and October***

By **STANLEY LEINWOLL,** Radio Propagation Editor

DURING the month of September, the autumnal equinox occurs. On this day (about September 23), the sun is directly overhead at the equator at local noon. As a result, both the northern and southern hemispheres get equal amounts of daylight and darkness. Because of this equalization, radio propagation conditions are at their best between the southern and northern halves of our globe during September and October.

This situation applies particularly to "antipodal" paths—where one end of a circuit is diametrically opposite to the other, such as a path between the East Coast of the United States and Australia. Over this circuit, the number of hours during which the entire path is either in complete darkness or complete daylight are at a maximum in the fall (and again in the spring when a similar equinox occurs).

**Long-Path Circuits.** Propagation graphs for two typical long-path circuits between the northern and southern hemispheres are shown in Figs. 1 and 2. Note the variation in maximum usable frequency—the highest frequency on which signals can be propagated between two locations for more than half the days of the month. Also shown on the graphs are the periods during which propagation conditions should be at their best because the entire path is all dark or entirely in sunlight.

From these curves it can be seen, for example, that on the East Coast of the United States reception from Australia and New Zealand will be best during the daylight hours from about 1 p.m. EST until well into the evening. The best bands during these periods should be 15, 16, and 19 meters.

It might be pointed out that reception over any circuit depends on many factors other than propagation conditions—including transmitter power, antenna characteristics, and the bearing of the antenna. Your reception is bound to be better when the transmitting antenna is beamed toward your area, and the higher the transmitter power and antenna gain, the better will be your chances of receiving the broadcasting station.

Reception of Australia on the East Coast during all dark periods will be best in the 25- and 31-meter bands during the nighttime hours, until approximately breakfast time. Similarly, best reception of Central and South African stations on the West Coast should be on 15 and 17 megacycles from early morning to mid-afternoon, and again in the evening on 7 and 9 megacycles.

**Fall Band Conditions.** On September 6, major schedule changes will be made by most international broadcasting stations. These changes will be made in accordance with an agreement signed in Geneva in 1959, and the new schedules will continue until November 1. Of the larger broadcasters,

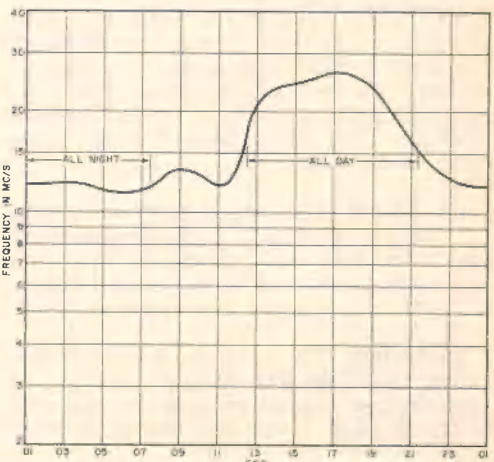



Fig. 1. Transmitters in New Zealand or Australia should be heard along the East Coast of North America in the 15-, 16-, and 19-meter bands during daylight (local) hours as the maximum usable frequency increases. There will be night openings on 25 and 31 meters.

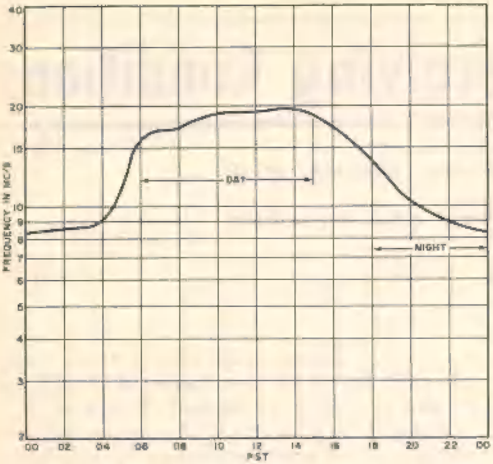



Fig. 2. This graph shows the maximum usable frequency between a transmitting station in Central or South Africa and an SWL receiving post on the West Coast of North America. See text for details.

only the U.S.S.R. does not conform to the Geneva Radio Regulations; major Soviet Union schedule changes will probably take place in mid-October.

**11 Meters.** This band will continue to be as dead during the fall as it was in the summer; during the minimum of the sunspot cycle the higher bands become less useful and the lower bands more important.

**13 Meters.** There was very limited use of this band by international broadcasters during the daylight hours in the summer, and as a result DX was also limited. There will be some DX in the fall, especially later in the season when the trend toward higher useful daytime frequencies begins. In addition, there should be some DX over circuits into the southern hemisphere, particularly from Africa and Australasia.

**16 Meters.** The DX on 16 meters will be better than in the 13-meter band. All major broadcasters have scheduled use of this band in the fall, and listening during the daylight hours should be fairly productive. Although there will be transatlantic and transpacific openings, the best signal paths will be from the southern hemisphere, from stations transmitting in Africa, South America, Australia, and southern Asia.

**19 Meters.** This will continue to be the best daytime DX band, with openings from some part of the world expected from around sunrise to sunset, and with activity dropping off after sunset until very little is heard.

**25 Meters.** The 25-meter band will not be very good for DX this fall. During the daylight hours signal propagation will generally be poor except for shorter distance openings from the Caribbean area, Central America, and Canada. At night long-path signals will skip too great a distance, but some stations transmitting from the southern hemisphere will be heard.

Propagation conditions in the 25-meter broadcast band should be best during transition periods, i.e., when daylight is changing to darkness, or vice versa. This limits the usefulness of the band to the several hours around dawn and dusk, local time.

**31 Meters.** During the daylight hours, 31 meters will be useful only over short-distance paths, to ranges of 1200 to 1500 miles. Conditions will improve during the early evening hours, when this could be the best band for DX. Later at night, reception will drop off, particularly in October when the seasonal trend toward lower useful nighttime frequencies becomes apparent.

**41 and 49 Meters.** These will be the best DX bands from local sunset to local sunrise, but during the daylight hours they will be all but useless—with whatever reception there is generally being from transmitters located under 1000 miles away. Interference (QRM) levels during the nighttime hours will again be high, with more and more broadcasters using these bands.

**60 and 90 Meters.** Propagation conditions on 60 and 90 meters during the past summer have not been very good due to seasonally high noise and absorption. However, with the night hours lengthening and noise levels decreasing, DX should improve noticeably—particularly in October.

**Standard Broadcast Band.** After a relatively quiet summer, DX should now start improving in this band. With sunspot activity expected to be low once again this winter, another record-breaking DX period is in the offing. Propagation conditions should get better in September, particularly on nights during which noise levels are low. On nights when 90-meter signals are especially good, broadcast-band DX will probably be unusually good also. —30—

# Hi-Fi Lab Check

## Dynakit Stereo 35 Power Amplifier

Manufactured by Dyna Company, 3916 Powelton Ave., Philadelphia 4, Pa.

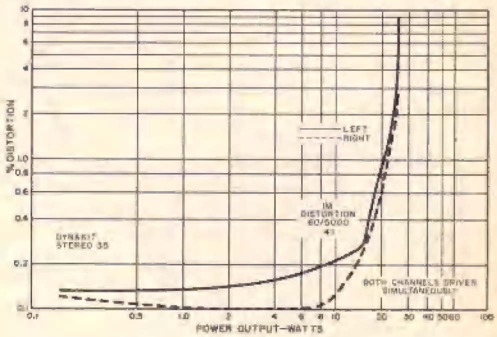
Prices: $59.95 (kit); $79.95 (wired)

THE POPULARITY of the Dynakit line of hi-fi units is largely due to the fact that they achieve maximum performance with the least number of components. This design philosophy has reached its zenith in the Dynakit Stereo 35 power amplifier. The circuit is so simple that you cannot help but wonder—why doesn't every hi-fi manufacturer build equipment this way?

Wiring the Stereo 35 took an astonishingly short time—two hours—including unpacking and plugging the amplifier in for testing. Partially prepared printed-circuit boards that require only interconnecting wiring to the transformers and tubes save a great deal of time. They also insure that the component layout is optimum, eliminating possible feedback or high-frequency loss problems.

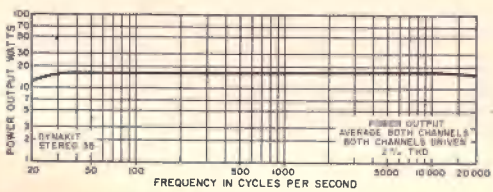
As shown on the graph below, power output per channel was better than 17.5 watts over most of the useful audio spectrum. The 20-cycle output (at 2% total harmonic distortion) was a respectable 13.4 watts. Driving only one channel, the output increases to 20.5-21 watts at 1000 cycles and 2% THD. Intermodulation distortion is remarkably low considering the physical size of this power amplifier—it was measured at less than 0.3% up to an output of 16 watts.

Apart from measurements, the Stereo 35 is clean-sounding and hum-free. It has good square-wave response, free from ringing and overshoot, and is absolutely stable with capacitive rather than resistive output loads. —30—

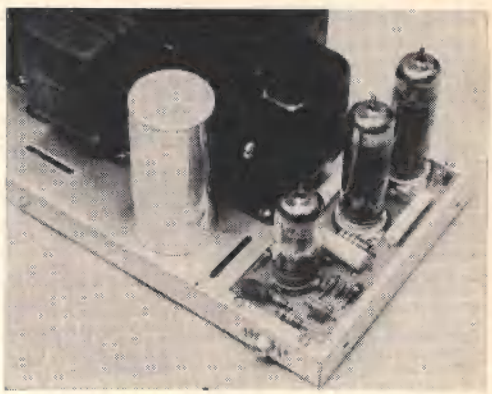



Intermodulation distortion as measured by the Hirsch-Houck Laboratories was below 0.5% for all output levels up to 17-18 watts output per channel.

Power output of the Stereo 35 was measured at 17.5 watts with very slight roll-off below 30 and above 15,000 cycles. This is surprising performance considering the small size of the power amplifier.




Each channel of the Dynakit amplifier consists of three tubes: driver/phase inverter and push-pull output. The printed-circuit components are premounted and soldered in place by the manufacturer.



## A Carl and Jerry Adventure in Electronics

# A Jarring Incident

ON a warm September afternoon Carl and Jerry were helping Bill Vardon tie down his Cessna plane at the small municipal airport. Bill, a schoolmate at Parvoo University, had just flown in from Texas to spend a few days with his two friends before going on to the World's Fair in New York. As they finished the job, Police Chief Morton and a stranger came toward them from the airport parking lot.

"Your folks said I'd find you here," the chief greeted Carl and Jerry. "I'd like you to meet Mr. Ringle, an insurance company investigator."

When Carl introduced Bill, the chief shook his hand, and said: "I don't want to interfere with your visit, but I always turn to Carl and Jerry when I'm stumped. In the past they've come up with some pretty outlandish electronic gadgets to solve my problems, and I'm hoping they can do the same for Mr. Ringle. Do you mind if we tell them about his problem?"

"Gosh no!" Bill replied. "The Wireless Boys here also have a pretty wild reputation at old Parvoo in the problem-solving department, and nothing would please me more than to see them at work."

"Good," Mr. Ringle said as all four squatted down in the shade of a wing. "I'll try to be as brief as possible. I have reason to believe that a family named Monk may have victimized insurance companies three times in the past and are getting ready to try it a fourth time right here in your town. This is the way they work their racket: A member

By
**JOHN T. FRYE**
W9EGV

of the family, who is heavily insured against injury while riding in an automobile, is involved in a one-car crash with no witnesses. In addition to some small scratches, the insured claims to have an injured back, a nerve irritation, or some other injury that is practically impossible to prove or disprove medically.

"Mr. Monk had two such 'accidents' and collected substantial sums both times. No company would insure him after that, but then his wife met with a similar accident and collected. Since that time I've had those two and their grown son under constant surveillance, and I followed them here from out west. They're staying at a motel near town, and every day they go for long drives along back roads. They have a CB radio in their car, and the son has a handheld transceiver. Sometimes they drop him off and drive around talking back to him from the car. We've monitored the conversations and they're innocent enough, but we think they're looking for a place to have another accident. They're probably testing the radio so they can give the son warning if the cops show up while he's faking his little catastrophe."

"The boy is covered by a large insurance policy, and yesterday he bought a used car," Chief Morton interrupted. "Since he already has a new sports car back home, that looks mighty suspicious. At our request, the car dealer is stalling on delivery for a couple of days to give us time to work out some plan."

"If the Monks stick to the MO that has worked so well for them in the past," Mr. Ringle continued, "this is probably what will happen: Late at night the boy will drive to a selected spot on a lonely road that parallels a ravine, canyon, quarry, or similar drop-off. He'll get out of the car, block the accelerator down, and jerk the shift lever into *Drive*. The car will hurtle over the edge of the bluff and be smashed down below. The boy will then work his way down to the car, remove the accelerator block, examine the damage, and make up a story to fit—the steering mechanism failed, or the headlamps went out, or the brakes locked. The damage will be such that his story can't be disproved. Finally, he'll tear and soil his clothing, inflict some small scratches on his body, then climb back to the road and wait to be discovered 'nearly unconscious.' His parents will have been watching from a strategic point to guard against anyone's discovering the wreck before it's ready to be discovered."

"We can't risk trying to keep a constant tail on the boy—not with his parents guarding his trail," the chief said. "What we need is something that will give an alarm the instant he wrecks the car and keep on signaling its location. Then, with a little luck, we should be able to reach the spot before the boy has finished setting the scene. Any ideas?"

Carl and Jerry registered deep thought, but no inspiration came.

"I may have an idea," Bill offered. "Last fall the Federal Aviation Agency conducted tests in California and Utah to determine the feasibility of crash-locator beacons for civil aircraft. I was interested, and George Moore, Director of Flights Standards Service, and James Rudolph, Chief of Operations Division of FSS, sent me reports on the tests.

"The beacons tested were rugged, low-power transmitters designed to break loose from a plane during a crash or to be released by the pilot just before a crash. The transmitter turned on automatically at separation. It was decided that the transmitter should be crystal-controlled on 121.5 mc., a frequency received by all FAA search equipment, and that it should put out a minimum of a quarter of a watt and be seventy to ninety per cent modulated by an audio note sweeping between 2000 and 2300 cycles two or three times a second."

"How far can a search plane hear such a signal?" Jerry asked.

"It depends on the altitude and head-

(*Continued on page* 98)

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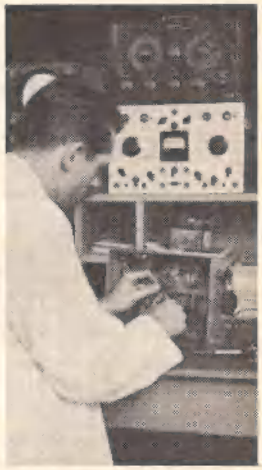

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## *INDUSTRY WELCOMES N.T.S. STUDENTS AND GRADUATES*

# On the Citizens Band

**with MATT P. SPINELLO,** KHC2060, CB Editor

## A CB'ER TAKES PART IN ALASKAN OPERATION

WHEN news of the devastating Alaskan earthquake that occurred last spring filtered through to the state of Washington, many families there feared for the safety of friends and relatives who lived or worked within the disaster areas. The family of Glen Stevenson, KFI1575, of Marysville, Washington, felt immediate concern. Glen's father-in-law, Clarence Olson, had been operating a crab cannery in the Cordova area, a stretch that appeared to have been hit by the center of the quake.

Glen first placed a call to the Civil Defense authorities. He was informed that the quake had crippled radio communications to Alaska; there was no information available for the moment. He then tried the Red Cross people, but found that they were already jammed up with so many calls that it would be a week or two before they could get any information to him. When he attempted to call his father-in-law by telephone, Glen was told that all phone lines to Cordova were down.

Then the Stevensons learned that ham operators were making contact with Alaska. Glen fired up his Olson "Spotter" CB transceiver and called a nearby amateur who was also a licensed CB'er. His request to the ham to try to reach his father-in-law through amateur frequencies was granted. Fortunately, the ham was able to contact Mr. Olson, who was himself trying to get through to Washington with his own amateur rig to let his daughter and son-in-law know that he was all right—although he had lost his Alaskan crab cannery.

As soon as word got out in the Marysville area that the Stevensons had made contact with Alaska, other people who had friends or relatives in the quake area began calling Glen and asking if he could get some word through for them. What followed took up the greater part of a 48-hour communications vigilance on the part of Glen Stevenson, his CB/amateur friend, and those amateurs in the quake area able to keep their gear fired up despite the damaging blow of the quake and the threat of tidal waves.

According to Glen, CB'ers as far away as Tacoma, Washington (60 miles from his base), asked for reports on people located within or near the quake area. Glen kept relaying the requests to the amateur, who received them on 11 meters and then attempted to plant the information in the laps of Alaskan hams who might be able to report on the people in question.


For two solid days after the Alaskan earthquake erupted, Glen Stevenson, KFI1575, and a fellow CB'er/amateur handled requests from people in the Marysville, Wash., area to try and locate friends and relatives in the quake area through amateur radio.

Photo courtesy of Marysville Globe

A most welcome assist was given to your OTCB Editor (far right) by CB'er Bob Reynolds, KHD0999, (center). Bob's car antenna appears to be growing out of the head of Dick Dresser, who made a different kind of assist—with wrench on rear tire.

Photo by Dick Rapp

As far as Glen Stevenson, KFI1575, is concerned, his CB'ing facility was definitely put to the test during those 48 hours when it was most needed. "Our CB transceiver came through with flying colors," claims Glen, "not only bringing welcome news to us but many others as well!"

**OTCB Editor Gets Aid!** Receiving written reports of emergencies handled by CB'ers each month, and placing them on these pages to inform our readers of these noble assists, is one thing. To actually put Citizens Band radio to use in a request for help—and then have assistance arrive on the spot in less than five minutes—is something else.

It happened to your CB Editor last May, somewhere on the John F. Kennedy expressway in Illinois. At exactly 70 m.p.h. (expressway limit), our left rear tire decided to blow. We peeled a bit of rubber for about half a mile, did a "twist-type" dance with the back half of our station wagon for an additional quarter-mile, and finally came to a halt, safely.

We then found that while we were equipped with a beautiful spare tire, we had only two-thirds of a three-part bumper jack—the base portion and the wrench. It was immediately decided that three of us (even combined) did not quite match up to the Samson-type qualities needed to hoist our vehicle off the ground and hold it there while a fourth person (which we did not have) made the tire change.

We placed just one call for help via CB radio, and received an immediate reply. Mobile unit KHD0999 was five miles behind us in a similar '63 model vehicle, carrying, of all things, all three portions of a three-part bumper jack! If it weren't for CB radio, we might still be there, waving helplessly at passing vehicles.

**CB'ers Trounced.** Although no CB equipment was involved, the members of the Keystone 11 Meter League, Royersford, Pa., volunteered assistance in a most unusual manner last winter. They competed on even terms with a group of professional

## 1964 OTCB JAMBOREE CALENDAR

Planning a jamboree, get-together, banquet or picnic? Send the details to: 1964 OTCB Jamboree Calendar, POPULAR ELECTRONICS, One Park Avenue, New York, N. Y. 10016. For more information on the jamborees below, contact the clubs or club representatives listed.

**Dalton, Ga.** — **September 4-7**
Location: Abertson Midget Lakes. Sponsor: North Georgia CB Radio Club, Inc.

**Crisfield, Md.** — **September 5-7**
Event: Labor Day Week End Jamboree held in conjunction with Crisfield Hard Crab Derby. Location: Crisfield Derby Grounds. Sponsor: Chesapeake Citizens Band Radio Club. Contact: Mrs. Ruth Brown, Club Secretary, Manokin, Md.

**Riverside, Calif.** — **September 6-7**
Location: Fairmont Park. Sponsor: 11-4 CB Club & Nationwide CB News. Contact: CB Jamboree, Box 8036, La Sierra, Calif.

**Lynwood, Calif.** — **September 11-13**
Event: Second Annual Home Show & Radio Communications Jamboree. Location: Bateman Hall, Lynwood Community Center. Sponsor: Southern California Radio Assistance Unit. Contact: Jim Servi, Box 127, La Mirada, Calif.

**Ontario, Canada** — **September 11-13**
Event: National General Radio Service Club Convention. Location: Hotel London. Sponsor: South Western General Radio Assn. Contact: Gerald Inch, President, 35 White St., St. Thomas, Ontario.

**Meadville, Pa.** — **September 12-13**
Event: CB Roundup & Barbecue. Location: Crawford County Fairgrounds. Sponsor: Citizens Radio Association of Crawford County. Contact: Chas. A. Boyd, Box 356, Meadville.

**Pittsburgh, Pa.** — **September 13**
Event: Picnic. Location: White Swan Park. Sponsor: Five-Eleven CB Radio Club, 868 Glass Run Rd.

**Fort Wayne, Ind.** — **September 20**
Event: Fall Roundup. Location: Allen County Memorial Coliseum. Sponsor: Maumee Valley Citizens Band Radio Association. Contact: Mort Knott, 2505 E. State St., Fort Wayne, Ind.

**Crescent, N. Y.** — **September 27**
Event: Tri-Club Chicken Barbecue Jamboree. Location: Halfmoon Beach. Sponsors: Troy Area CB Club, Schenectady Electric City CB'ers, Saratoga Spa Ten-Fourers. Contact: Stephen Stracher, Box 299, Lans. Station, Troy, N. Y.

blind bowlers—all the Keystone participants were blindfolded.

The Keystone CB'ers learned beforehand that the blind bowlers guided themselves by means of a special handrail. So the CB'ing group constructed a practice rail of their own, a week in advance, confident that this was all they needed to match the pros. The results were rewarding—until the real thing came along! The blind bowlers went so far as to allow the Keystone team to remove their blindfolds for the last game, with the CB'ers spotting them 100 pins. To no avail! Final tallies brought the Lancaster County Blind Bowlers out on top.

Jack Hartman, the Keystone CB'er who told us about the match, seems to have drawn the honors for the biggest boo-boo pulled during the practice session. Jack couldn't understand why his first ball never returned. It seems that (blindfolded) Jack had tossed the ball down the walkway near the wall; it continued out the back door of the bowling alley and wound up in a snow bank!

**Club Chatter.** Thea Bernard, editor of the *4W24 CB Club News*, forwarded the accompanying photo of past and present club officers taken at the club's annual installation dinner/dance held last April. Left to right are: George Bernard, vice president


1963-64; Bob Huttenlock, president 1963-65; Dick Corbett, president 1962-63; Sid Butterfield, president 1961-62; Curtis Plummer, executive director of the Federal Communications Commission; Jim Barr, special services administrator; and Henry Nebel, president 1960-61.

Founded in 1960, the 4W24 club takes in the areas of Maryland, Virginia, and the District of Columbia. According to Thea, when the club was organized the only calls assigned to the area were 4W and 24W. Despite the fact that some day soon there may only be KKI and KLV type calls in that area, the club members hope to keep the original "4W24" in their title—for sentimental reasons.

The Goodfellows Citizens Band Radio Club, of Northlake, Ill., was organized less than a year ago, and plans to release the first issue of the club newspaper shortly. As shown in the accompanying photo, present officers include: (front row) Ron Henselman, KHC8161, junior representative; Myrna Christenson, KHD9255, secretary;

Marty Mendelson, KHA5672, president; (back row) Vi Henselman, KHC8161, women's representative; Bob Christenson, KHD-9255, social secretary; Chester Neal, KHD-5629, sergeant-at-arms; and Norm Worthem, KHC9857, treasurer. Vice president Howie Lippit, KHB2160, was not around when the photo was taken.

In Durant, Mississippi, the Holmes County CB Club has a membership of about 50. Shown in the photo are the current officers and a few members at a recent bash. Front row, left to right: Mrs. Ernest Saxton, treasurer; Ernest Saxton, vice president; Newton Fox, president; and Jimmy James, secretary. Second row: Patty Houston, Hubert

Moss, Buddy Hathcock, Frank Hudgins, and Hilda Fox. Third row: Murry Cain, Walter Perry, James Engle, and Sonny Harcrow.

**State Badges.** Planning on attending one, or several, of the events mentioned in the OTCB Jamboree Calendar? You may be interested in the latest identification "rage" being distributed by K9TVA Enterprises: badges shaped like states. You can get one shaped like your state, and engraved with your name, call letters, and location—so

there will be no question as to where you hail from.

The new State Badges are available in several sizes, with your choice of backs: pin with safety catch, clutch pin, or an adhesive backing. Drop a line to K9TVA Enterprises, 6429 North Glenwood Ave., Dept. P84, Chicago 26, Ill., and ask for information on the State Badges and a copy of their latest brochure.

**CB Club Roster.** The following new clubs have been added to the 1964 OTCB Club Roster:

- Penova Citizens Band Radio Club, Box 606, East Liverpool, Ohio 43920. Officers: Brooks Mayfield, KHI3070, president; Floyd Saltsman, 19Q5013, vice president; Ruth Mayfield, KHI3070, treasurer; Ellen Saltsman, 19Q5013, secretary; Bob Kincaid, KHJ8783, activity manager; Virginia Craig, KHI7554, publicity. Club paper: *The Chatter Box*, handled by Dick and Elaine Green, KHJ0769. Membership: 100.
- Citizens Radio Association of Rockland, Inc., Box 295, Nanuet, N. Y. 10954. Officers (for 1963-64): Robert Knight, 2A4802, president; Gerald Steinberg, 2W5714, vice president; Fred Schley, KBI1888, secretary; Lee D'Agostino, KBI0425, treasurer. Membership: 18. Organized in 1959, this club has just converted a milk truck into a mobile communications van containing complete CB facilities; mobile and base-type antennas; police, fire, and civil defense equipment; and first aid gear.
- Greater Baton Rouge Citizens Communications Association, 510 Bluebell St., Port Allen, La. Officers: Wm. E. Boucher, KKR0281, president; Lee Wilson, 8Q1520, vice president; Wm. Johnson, KEB1338, secretary; and Fred Dawson, KEA1372, treasurer. Membership: 75.
- Other new clubs are: Citizens Band Radio Relay League, Inc., Staten Island Chapter, 694 Henderson Ave., Staten Island, N. Y.; Citizens Band Service Club of Western Pennsylvania, Box 260A, Washington, Pa.; 11-Meter Emergency Service of Ohio, I.A.A.P., Chapter 162, Mansfield, Ohio; Crossroads CB Club, 2965 E. Maple Rd., Clare, Mich.; The Little Rhody CB'ers Club, 96 Sterling Ave., Providence, R. I.; and the Houston CB Club, Houston, Texas.

If you haven't sent us the lowdown on that successful jamboree your club had, do it now; and don't forget to include pictures. Address mail to: Matt P. Spinello, KHC2060, POPULAR ELECTRONICS, One Park Avenue, New York, N. Y. 10016.

I'll CB'ing you.

*—Matt, KHC2060*

## The Fabulous Fuel Cell

(*Continued from page* 50)

produced other than a small amount due to electrochemical inefficiencies. The fuel cell thus becomes the world's most perfect generator of electricity. With no moving parts and no energy-wasting boiler-turbine combinations which convert fuel by burning it, the fuel cell strips electrons from the fuel and sends them into an external circuit to do useful work!

**Waste Products.** Referring back to the fuel cell drawing, the stripped atoms of fuel, now positive ions, migrate back through the electrolyte to the cathode where they combine with the oxidant to produce water, a "waste" product which, incidentally, may prove very useful. Depending on the fuel used, a waste product is also produced on the anode side of the fuel cell; in the case of hydrocarbons, this is carbon dioxide as in a gasoline engine. Unlike a gasoline engine, however, which may have at most a conversion efficiency of 30 to 40 per cent, the fuel cell has efficiencies of 50 to 60 per cent at present, and theoretical levels up to 98 per cent.

Another big fuel cell advantage is that air can be used as the oxidizing gas. This completely eliminates the need for a separate oxygen supply for cells operating anywhere on the earth's surface. Of course, cells lofted into outer space must carry their oxygen. The one disadvantage of using air is the lower productivity that results. When a cell is pressurized, the available yield in amperes per square foot of electrode goes up. As the device operates, its temperature also goes up (due to the inefficiencies mentioned earlier) which further raises the yield.

While fuel cells using inexpensive hydrocarbon fuel (i.e., anything from natural gas to gasoline to diesel fuel) hold the most promise for future down-to-earth commercial applications, there is still a great deal of developmental work ahead. One of the major obstacles is the high cost of the platinum alloy electrode material which seems to hold the key to making these inexpensive

fuels react to produce electricity in a fuel cell.

**High-Temperature Cells.** Raising the operating temperature raises the cell's output, but with one bad side effect—it causes corrosive action at the electrodes, a condition that can ruin the cell after a relatively short time. But the advantages of elevated temperatures can be retained by the use of a solid electrolyte designed to withstand them. One such material in use is lime-stabilized zirconia.

In a cell of this type, a fuel such as methane (natural gas) is fed to one side of the cell where it forms carbon on the electrolyte surface. The carbon becomes both the anode and the fuel. The operating temperature of this cell is normally about 1800° F (about 985° C). This temperature is above the melting point of silver and it is molten silver which forms the base for the negative electrode. Oxygen is diffused into the silver, and the high operating temperature is maintained simply by burning off gases within the cell. High-temperature cells in this category have produced current densities up to 150 amperes per square foot of electrode area. Nominal voltage for such a cell is 0.7 volt, making the single-cell power output a little over *100 watts per square foot of electrode.*

A further development that is still being evaluated is known as the "Redox" (*red*uction and *ox*idation) cell. This device involves a two-step process in which an intermediate gas-liquid reaction occurs in the electrolyte itself. The Redox cell, although it isn't as efficient as the more conventional types, has lower internal resistance losses which more than offset the lower efficiency level. It is still largely experimental, however.

**Fuel Cells in Outer Space.** The state of the art has advanced sufficiently in certain cell types to make it possible to use fuel cells in space vehicles. Several experimental devices have been lofted into outer space as part of a testing and evaluation program. The units tested have shown virtually no effects from prolonged periods of weightlessness and high-gravity acceleration and deceleration. Cells recovered from space probes have continued to function

normally in laboratory life tests, still operating at optimum efficiency.

In fact, the space testing has been so successful that G.E. is now building fuel-cell modules for use in the Gemini space program at the rate of one complete system every two weeks. The first systems have been delivered, and one is scheduled for launching later this year—perhaps even as you read this—as part of the equipment of the unmanned Gemini Number Two space vehicle.

The Gemini system is made up of twin canisters two feet long and a foot in diameter, each containing 100 individual solid-electrolyte (the electrolyte portion of each cell is known as an "ion-exchange membrane") fuel cells. The system is highly reliable, has a high power output (up to two kw.), and is much lighter in weight (145 pounds not counting fuel) than any other comparable power source.

By way of comparison, a typical fuel cell system designed to provide outputs of 500 watts to two kilowatts for 10,000 hours reliability weighs (including fuel) between 400 and 500 pounds. Solar cells and battery systems with comparable outputs and reliability would weigh in the neighborhood of 700 pounds. And solar cells have a further disadvantage. Because they must be mounted externally on the space vehicle, they are especially susceptible to damage by radiation and minor meteor collisions.

The twin cylinders installed in Gemini Two each contain three fuel-cell stacks which can be operated separately depending on power supply requirements. The fuels are stored at temperatures near absolute zero, and waste heat generated within the cell is carried off by a circulating cooling system. Another aspect of the fuel cell is its by-product: potable water. In Gemini, the water will be made available for consumption by the astronauts who man future vehicles, thereby reducing the payload.

**Military Applications.** Compared with conventional power sources in size, weight, and maintenance required, the fuel cell offers some enormous advantages. In a typical military field application, such as providing power for a front-line communications outpost, the fuel cell is expected to surpass such power sources as primary batteries, sec-

ondary batteries including nicads and wet-cell storage types, and the frequently used gasoline-driven motor-generator.

The primary batteries have to be replaced frequently, especially if they must deliver sustained current outputs for radio transmission.

Secondary batteries must be recharged. This means using a noisy (and therefore frequently undesirable) motor generator set or replacing the batteries at regular intervals with recharged units brought up from the rear. The motor generator itself may be too cumbersome to bring up to some positions, its noise of operation can attract the enemy's attention, and it must be constantly pampered, fueled and maintained.

The fuel cell is completely quiet in operation. It can deliver sustained high current for indefinite periods of time, and it is fueled with easily transported gases or liquids. In fact, the total weight of a fuel cell system along with enough fuel to run it for several weeks may be less than the weight of a comparable set of storage batteries that require constant recharging.

And powerful they are. On the basis of present-day technology, fuel cells will soon be able to deliver about a kilowatt for every 15 to 20 pounds of weight! Yet another advantage of fuel cells as compared to gasoline engines, for example, is that fuel cell efficiency increases with partial loads, and under no-load conditions, no fuel is consumed at all. This no-load no-consumption feature separates the fuel cell from both engines and conventional electro-chemical batteries. Any engine uses fuel when it is idling.

**Future Uses.** Earthbound applications for fuel cells in the near future include providing power for electric switching locomotives; experts believe that such an all-electric system will be far more efficient and easier to control than the conventional diesel-electrics in common use today. Powering midget submarines is another potential application, although the subs will have to carry a canned oxygen supply for extended periods of deep under-surface travel; a snorkel will provide air for shallow operation.

One of the most intriguing possible uses is in the electric automobile. Several years ago, a major manufacturer of solar cells exhumed a museum-piece electric car and covered its roof with solar cells as a publicity stunt. The car ran beautifully as long as the sun was shining. What was possible with primitive turn-of-the-century batteries and today's solar cells will certainly be feasible with fuel cells. If the car's cells use methane, the car can be refueled simply by having the local power company run a pipe for natural gas into the garage. Refueling on the road will be done the same way, via natural gas outlets in filling stations. And it'll be a lot cheaper than gasoline. There will be far less maintenance required, too, since an electric motor has just one moving part.

As a portable source of direct energy conversion, the fuel cell appears to hold almost unlimited promise. Its ruggedness and reliability have already been proven in the rigorous environments of outer space and re-entry, and continuing tests indicate an almost incredible lifespan for this electrochemical generating device. —30—

## A Jarring Incident

(*Continued from page* 85)

ing of the plane. When flying away from the beacon, the pilot could hear the signal thirty miles at 1000 feet, fifty miles at 5000 feet, and sixty-five miles at 10,000 feet. Because of the directional characteristics of the plane's Posifix antenna mounting, these ranges were all cut thirty-three to forty per cent when the plane was flying toward the beacon. More important, though, the pilot quickly located the beacon in all cases and was able to fly within 300 feet of a vertical line straight above it."

"That's it!" Jerry exclaimed, jumping to his feet and bumping his head on the plane wing in the process. "We build a ten-meter transistorized transmitter—transistors can take the shock—in a steel case and fasten it to the bottom of the car with a spring-loaded clamp. A crash will throw the transmitter free and start it sending. We install a transistorized ten-meter receiver and direction-finding loop antenna that we use for hidden transmitter hunts in Bill's plane. You fellows alert us when you think the Monks may stage their accident, and we take to the air. As soon as the wreck occurs, we pick up the signal and quickly track it to its source. The location is relayed to you on the plane's radio, and you rush out and try to catch young Monk *flagrante delicto.* How's that?"

"Very good, including your legal Latin," Mr. Ringle replied. "It sounds just wacky enough to work. But how long will it take you to build the transmitter?"

"We'll be ready to install it on the car tomorrow morning and can check it out in a couple of hours," Jerry promised.

"Good enough!" Mr. Ringle said enthusiastically. "See you tomorrow."

BILL FOUND a steel case shaped like half an egg-shell in a junk yard, and they poured lead in the bottom so that it would always return to an upright position after being moved, like a humpty-dumpty toy.

Jerry "lifted" the transistorized transmitter circuit bodily from a CB 1-watt transceiver. The modulator was driven by an audio oscillator, and the collector of this oscillator and the collector of a blocking oscillator were fed through a common resistor. Any change in the audio oscillator collector voltage produced by the varying current demands of the collector of the blocking oscillator produced enough frequency change to make the signal easily identifiable.

Carl's contribution was a self-erecting antenna. A compact telescoping antenna was base-loaded to resonance when fully extended some 50 inches. He installed a $CO_2$ cartridge from a BB pistol inside the case and arranged for the gas to be released inside the sealed hollow tubing of the collapsed antenna shortly before the transmitter was turned on by a delayed-action switch. This caused the antenna to shoot up to its full length through a foil-covered hole in the top of the case. The first time they tested it, too much pressure tore the antenna in two and buried the tip of it in the ceiling of the basement laboratory, but a safety valve cured that.

The case was mounted on its side in a spring-loaded holder designed to bolt to the bottom of the car body. The spring tension was adjusted so that it would hold the case firmly in place during ordinary road shocks transmitted through the car's suspension system and yet release it if the body of the car received a heavy jar.

It was after midnight when the trio finished their work, but they were at the police garage at seven the next morning to install their brainchild on the used car. This did not take long, and they were soon on their way to the airport to install the direction-finding equipment in Bill's plane. To test it, they removed the beacon transmitter from its case under the used car and brought it along.

The small shielded loop was mounted on the end of an aluminum tube thrust up through a small hole in the floor of the plane. Flexible coax cable connecting the receiver to the loop permitted the latter to be turned freely on its vertical axis and to be rocked through a considerable arc on its horizontal axis.

Then Carl drove away with the bea-

con transmitter to "plant" it, and a few minutes later Bill and Jerry took off in the Cessna. When Carl turned on the transmitter, Jerry picked up the signal immediately; and in very short order the plane was circling over the spot where Carl had hidden the transmitter. Satisfied with their test, they returned to the police station and replaced the transmitter in its concealed case.

THE CAR was delivered to the Monk boy that afternoon, but nothing happened! Two days went by while the three of them chewed their fingernails. Wherever they went, arrangements were made so that Chief Morton could reach them quickly, but he never called.

On the evening of the third day they went bowling. Jerry was paged about 10:30. The chief was on the phone.

"This may be it," he said. "The young guy has just taken off in his car. Get into the air as soon as you can and keep listening for me on that portable police receiver I gave you."

Quickly the boys drove to the airport, warmed up the Cessna, and took off. It was a calm, moonlit autumn night, perfect for flying. As they circled out over the countryside, the voice of Chief Morton came from the little portable police-frequency receiver: "We've tailed the boy in a big circle out north of town, but now we've got to drop him. Our stake-out at the motel says the parents have just driven away, and they're probably going to watch his trail to see if he's being followed. It's up to you fellows now. Mr. Ringle and I will be standing by at the station."

While Bill cruised over the city at about 3000 feet, Jerry, sitting in back, strained his ears and moved the loop antenna. Carl sat beside Bill with a pair of 7 x 50 binoculars in his lap. Minute after minute ticked by with nothing happening; but then, close to midnight, the little ten-meter receiver suddenly came alive with a rhythmic "wheee-wheee-wheee" sound.

"That's it!" Jerry shouted, maneuvering the loop delicately. "It's coming from either east or west. Try flying east."

Bill obeyed, but in a couple of minutes the signal was noticeably weaker.

"Turn around," Jerry ordered. "It's coming from the west."

Shortly after they turned, the signal began to build in intensity, and it continued getting stronger as they flew west along the river, gradually losing altitude. Jerry actually tracked the signal's direction by keeping his loop oriented for minimum signal strength; the nulls of a loop antenna are much sharper than the lobes. In two or three minutes even this minimum signal was showing strongly on the S-meter, indicating that they were getting very close to the transmitter.

"He must have driven the car off that high limestone bluff at Cedar Rapids," Carl muttered, scanning the river bank below with his night glasses. "It's just ahead. Throttle back and fly as low as possible so I can get a good look—hey! I see the car! It's right there at the bottom of that big white bluff! If the chief and Mr. Ringle drive out the highway to that cement plant and then walk across the railroad tracks and that field, they can reach the top of the bluff with-

out being seen by anyone parked along the river road."

Bill was already relaying this information to the airport operator who had been alerted to give it instantly to the police. At the same time Bill was coming in for a landing at the airport. The wheels of the plane had hardly stopped turning when the fellows piled out of the aircraft and ran to their car. Fortunately the airport was on the west side of town, and within minutes they were sliding to a halt beside Chief Morton's car parked at the deserted cement plant along the highway.

Hastily but silently they scrambled over the railroad embankment and ran across a pasture that separated the railroad from the river road. Very carefully they approached the top of the bluff and crawled to where the chief and Mr. Ringle were lying on their stomachs peering over the edge. A movie camera hummed quietly in Mr. Ringle's hands, recording the scene.

Straight below them, clearly seen in the bright moonlight, a young man was methodically tearing his shirt and trousers and smearing dirt into the garments. Then, while they watched and cringed, he heated the point of a large needle in the flame of his cigarette lighter and used it to inflict several scratches on his face, chest, and forearms. This done, he took a last careful look at the broken wreckage and started walking upstream.

"Let's go," Mr. Ringle whispered, shutting off his camera. "We don't need to hurry. He has to walk almost a quarter of a mile up-river before he can climb back up on the road."

"Aren't you going to wait and arrest him?" Carl demanded.

"Not now," Mr. Ringle replied. "I'll wait until he files a claim backed up with the big lie he's preparing right this minute. Then I'll spring the pictures made on the special ultra-fast film in this camera. With your testimony to back me up, I think we'll be able to recover any of the insurance money the Monk family has left. Jerry, what were you looking for with those binoculars off to the right of the wreck?"

"For what I spotted," Jerry said with a grin. "Our little beacon was jarred

loose as the car went over the edge of the cliff and is lodged against a small shrub about halfway down the slope. As soon as young Mr. Monk is 'found,' Carl and I will come back with ropes and get the transmitter before someone sees it and starts wondering about it. We don't want to start any more flying-saucer stories!" —30—

**Experimenting With Sonar**

*(Continued from page 45)*

Edition of the ELECTRONIC EXPERIMENTER'S HANDBOOK, you are now fully acquainted with its operation. It will receive AM or c.w. signals, but tuning in an AM signal is difficult and can be made much easier bv altering the circuit shown at the top of page 45.

The modification consists of adding a d.p.d.t. slide switch on the *Sniffer* box so that the local oscillator is disabled and the mixer is changed to a detector. If you compare the original wiring diagram and the modified version shown on page 45, the wiring changes become obvious. Simply remove the end of *R10* from the circuit board connection to the base of *Q3* and solder it to one of the center terminals of the new d.p.d.t. switch. When this switch is in the AM position, *R10* will be disconnected, but in the c.w. position *R10* will be connected back to the base of *Q3*.

On the other side of the d.p.d.t. switch, add two short wire leads to coil *L2* as shown in the modified wiring diagram.

**Testing It Out.** Your *Sniffer* has no automatic gain control (or a.v.c.), so the tone signal from the transmitter will be quite loud when the two units are in close proximity. As the distance increases, you will find it necessary to turn up the gain on the *Sniffer* until the signal fades into the background hiss. You can key the tone signal for straight c.w. if you desire. The range will be somewhat greater than with voice or music modulation.

Don't forget that the *Sniffer* and the transmitter are directional and that the open ends of the transducers must face one another. —30—

## Transistor Topics

(*Continued from page* 78)

tenna (*L1*) and a conventional 365-$\mu\mu$f. tuning capacitor (*C3*). Switches *S1* and *S2* are s.p.s.t.'s while the power supply is a standard 9-volt transistor battery (typically, a Burgess 2U6).

Although almost any desired construction method can be employed, best results will be obtained if the circuit is wired on a phenolic or etched circuit board and assembled in a metal instrument case, such as a small Minibox. Standard test jacks can be used for output connectors. If you wish, you can give the completed assembly a "professional" appearance by labeling the power switch (*S1*), a.f.-r.f. switch (*S2*), tuning control (*C3*), and output jacks with appropriate decals or metal name plates.

**Transitips.** Microphones are required for many reader projects—typically, home broadcasters, p.a. systems, small phone transmitters, "detectaphones," science fair projects, and so on. But commercial microphones are relatively costly and even basic mike cartridges are not inexpensive. There are, fortunately, a variety of microphone substitutes that can be used by the ingenious experimenter. Often, a suitable microphone can be found in the junk box. While not of "broadcast quality," most of these substitutes are quite satisfactory for hobbyist applications.

A speaker makes an excellent *low-impedance* microphone and can be used in high-impedance circuits when combined with a standard output transformer wired "in reverse"—that is, the transformer's low-impedance output winding is connected to the speaker's voice coil and its high-impedance "primary" drives the equipment with which the microphone is to be used.

A standard magnetic headphone will serve as a *moderate-impedance* microphone. With a rated impedance of from 500 to 2000 ohms, such units are almost a perfect match for most common-emitter transistor amplifier circuits.

Small crystal earphones of the "hearing aid" type can be used as *high-impedance* crystal microphones if the earplug is replaced with a conical mouthpiece—a thimble with its bottom removed, for example. A matching transformer (high to low impedance) can be used for low to moderate impedance circuits.

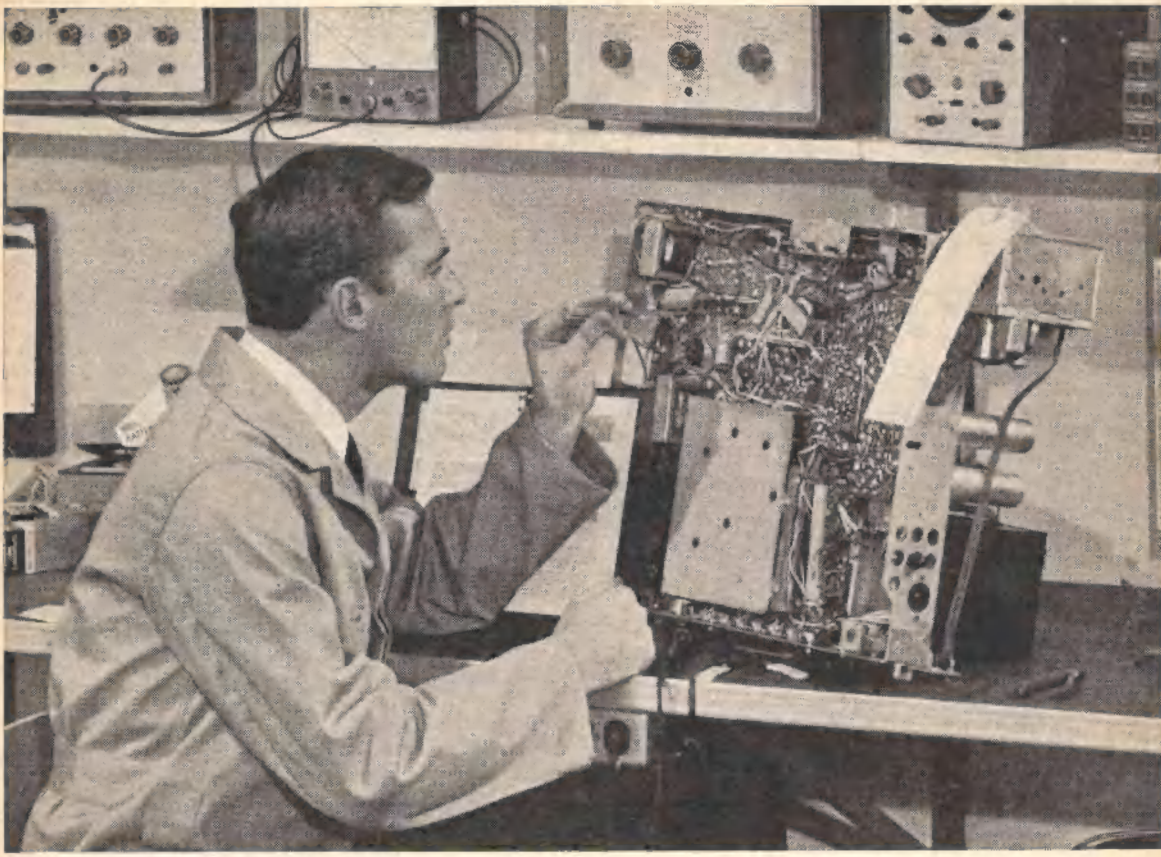
Finally, if a carbon microphone is needed, one can be salvaged from a surplus or discarded telephone handset. Such units require a source of d.c. voltage, of course, and have a moderate to low output impedance, but they also have the highest output (greatest sensitivity) of any available microphone.

As with conventional units, shielded cable should be employed between the microphone and the amplifier (or other equipment) with which it is used to minimize hum and noise pickup.

**Forever?** Engineers have known for some time that transistors and related semiconductor devices do not "wear out" in a conventional sense. A major manufacturer, the Westinghouse Electric Corporation, has now acknowledged that fact by extending a *lifetime guarantee* on all of its JEDEC-registered silicon power semiconductor devices. The guarantee applies for the life of the original equipment in which the devices are used. Full details covering the scope of the guarantee and its terms are available from the firm's distributors.

That closes our part of the book for now, fellows. We'll be back next month with more circuits and news.

—*Lou*



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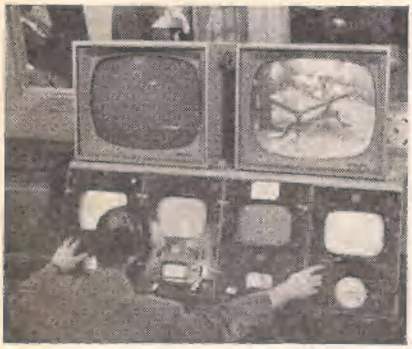

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## Across the Ham Bands

(*Continued from page* 80)

doubters had a point: SSB transmitters *were* complicated!

The filter-type transmitters generated their SSB signals at a frequency below 20 kc. because suitable filters could be built only for very low frequencies (today's high-frequency crystal lattice filters were still on the designers' drawing boards). The resulting SSB signal then had to be heterodyned up to the desired output frequency in steps by feeding it through several oscillator/mixer stages. Obviously, this process introduced circuit complications.

In transmitters using the phasing method of generating the SSB signal, the original, low-power AM signal is taken apart electronically and then reconstructed as an SSB signal. An advantage of this method of generating SSB signals is that it can be done at any frequency. But early phase-shifting networks were complex and difficult to adjust.

Of course, the dedicated SSB advocates contended that, even if SSB transmitters were complicated (which they seldom admitted), SSB's superior performance made the complications worthwhile. True or not, one trouble with this reasoning was that SSB was very slow in making new converts—at least at first.

**The "SSB, Jr."** A big breakthrough in the search for SSB transmitter circuit simplicity occurred in late 1950. In the November-December, 1950, issue of the GE *Ham News* (Vol. 5, No. 6), Donald E. Norgaard, W2KUJ, described the "SSB, Jr.," a complete, 3-tube (12AU7, 12AT7, 6AG7), 5-watt, phasing-type, 75-meter SSB transmitter. The little transmitter featured a simple audio phase-shift network and diode-balanced modulators to generate the SSB signal. Soon many "SSB, Juniors" began appearing on the air, especially after commercially manufactured versions of the Norgaard audio phase-shift network appeared on the market.

But the "SSB, Jr." was only a single-band unit until Wes Schum, W9DYV, modified its basic SSB generator circuit for 9-mc. operation and inserted a mixer stage between the generator and the output stage. In this way, by mixing the 9-mc. SSB signal with another signal of the proper frequency, an SSB signal could be simply produced on any amateur frequency. A variable frequency oscillator (VFO) is the usual source of the beating signal.

Wes Schum also added a voice-operated transmit/receiver relay (VOX) and a built-in power supply to the basic "SSB, Jr.," and the famous Central Electronics 10A SSB transmitter was born. The rapid and widespread acceptance of the 10A and later Central Electronics' SSB gear put enough SSB signals on the air to convince most progressive amateur phone operators (and other manufacturers) that SSB was here to stay.

Although there have been many changes in the SSB picture over the years, practically every SSB transmitter on the air today can trace one or more of its operating features to W2KUJ's original circuit and W9DYV's improvements.

## News and Views

**Dave Stratton, WB6JMQ,** 720½ E. Fairview, Inglewood, Calif., runs 60 watts input to his Knight-Kit T-60 transmitter. A Hallicrafters SX-140 receiver and a Hornet vertical antenna complete his modest station. Dave has worked 45 states and has QSL cards from 42 of them. His DX brag list includes Japan, Russia, Australia, Brazil, and quite a few more countries; he needs Africa, however, for his WAC (Worked All Continents) certificate . . . **Dave Robel, WAØGMF,** 521 Eastridge Dr., Lincoln, Neb., has made close to 800 contacts in his ten months on 2 and 6 meters. On 6 meters, he has worked 39 states with his Gonset G-50 transmitter/receiver connected to a Hy-Gain six-element beam 50′ high. He also has a home-built 10-watter and the "Simple Superhet for 6" described in our April, 1963, issue. A Heathkit "Two-er," an eight-element Hy-Gain beam, and some miscellaneous gear take care of 2 meters. Oddly enough, his best 2-meter DX (60 miles) was worked with the 6-meter beam . . . **Bill Bross, WN5IBM,** 4022 E. Virgin Pl., Tulsa, Okla., does his electron agitating on 40 meters. Bill's home-brew transmitter and Drake 2B receiver have put 19 states from coast to coast in the WN5IBM logbook. His antenna is 42′ high.

**Marion "Jack" Jackson, Jr., WA4LDM,** 1402 Azalea Dr., Florence, S.C., says that operating from South Carolina is almost like being rare DX—everybody he works wants his QSL card. Because he makes so many contacts, however, he can only answer cards received. A Heathkit DX-35 transmitter, a Hallicrafters SX-99 receiver, a 14-AVS vertical antenna, and an 80-meter "long-wire" antenna have enabled Jack to work 48 states and 20 countries on 80, 40, and 20 meters. Of course, he runs high power—if you call 35 watts on c.w. and 16 watts on phone high power . . . **Mike Ford, WN9KFQ,** 3502 Oliver St., Ft. Wayne, Ind., has worked 34 states, Canada, Guantanamo Bay, the Canal Zone, and Mexico on 40 meters. He transmits with a Knight-Kit T-60 and receives on a Gonset

GR-91; his antenna is a dipole 30′ high . . . **Junior, WN5HJV,** RFD 2, Armory, Miss., is a man of patience! During his first seven months on the air, he made exactly five contacts—all with the same (local) station. Then a friend traded him a 40-meter dipole. In the following three weeks, he made 32 contacts in 12 states—with his Knight-Kit T-60 transmitter and "Star Roamer" receiver. WN5HJV is still looking for a good "long-wire" antenna for 80 meters after trying ten that didn't work.

Did you know that **Don Stone, K7DWT,** Lakewood, Wash., was the ham who broke the news of the Alaskan earthquake to the world? At 7:28 p.m., PST, March 27, he was working a mobile station in Anchorage. The Alaskan ham said, "I believe we're having a small earthquake. I can see a ripple in the ground." A moment later, he cried, "Oh, my God! The ground is waving like an ocean!" After breaking the news to TV station KVI, Seattle, K7DWT spent the next ten hours on the air without a break handling emergency messages in and out of Alaska . . . **Carl E. Krasnor, KN1FPI,** 184 West Allen Ridge Rd., Springfield, Mass., works 40 meters with a Heathkit DX-35 transmitter and a Globe Chief Deluxe transmitter. He also has two receivers, a BC-455 "Command" receiver converted for ham use as described in P.E. (June, 1963), and a home-brew receiver. In four months of operation, this setup has put 300 stations in 32 states and Canada in the KN1FPI logbook.

If **Matt Harris, WN5IBV,** 422 Retama, Harlingen, Texas, had been born 30 miles further south, he might be signing an XE2 call. As WN5IBV, Matt "wasted" five months trying to work stations with a poor receiver. Then he got a Hammarlund HQ-110; three months later he had racked up 35 states, Canada, Argentina, and Peru. A Heathkit DX-60 transmitter feeding an inverted-V antenna completes Matt's station . . . **Marshal Lopez, Jr., KP4BLS,** 1442 Americo Salas St., Santurce, Puerto Rico, operates all ham (phone and c.w.) bands between 3.5 and 29.7 mc. A Heathkit DX-60 feeds either a Mosley TA-33 tribander beam or an 80/40 meter dipole. Marshal answers all valid SWL reports which are accompanied by a stamped, addressed reply envelope. Contacts are QSL'ed via the ARRL QSL Bureaus. KP4BLS gets on 10-meter phone for at least a few minutes every day between 2000 and 2300 GMT—watch for him . . . If you need Canada, **Ernie Klienman, VE2AVQ,** 2310 Ekers Ave., Montreal, Canada, will sked Novices on 80, 40, or 15 meters.

Before closing the column for the month, we'd like to offer a special word of thanks to all the amateur radio clubs that have been mailing us their club papers and bulletins. We appreciate being put on the mailing list to receive *your* club bulletin, too.

When will we have *your* "News and Views," photo, or suggestions? Address all mail to: Herb S. Brier, W9EGQ, Amateur Radio Editor, POPULAR ELECTRONICS, P.O. Box 678, Gary, Ind. 46401. 73,

*Herb, W9EGQ*

## Short-Wave Report

(*Continued from page* 66)

### Current Station Reports

The following is a resumé of current reports. At time of compilation all reports are as accurate as possible, but stations may change frequency and/or schedule with little or no advance notice. All times shown are Eastern Standard and the 24-hour system is used. Reports should be sent to P.O. Box 333, Cherry Hill, N.J., 08034, in time to reach your Short-Wave Editor by the eighth of each month; be sure to include your WPE Monitor Registration and the make and model number of your receiver. We regret that we are unable to use all of the reports received each month, due to space limitations, but we are grateful to everyone who contributes to this column.

**Andorra**—*R. des Vallees-Andorre* has been reported in Europe on 9000 kc., dual to the usual outlet on 6305 kc. While this is suspected to be some form of an image or harmonic, it may be worthwhile to check the channel from time to time.

**Austria**—Vienna has been noted on 11,840 kc. in native language to the Middle East and on 9770 kc., dual to 9525 and 7155 kc., from 2030 to 2055 s/off with multilingual anmts, ID's, and requests for letters.

**Basutoland**—The new call for ZRE41 is ZNF4V. This station is on the air Saturdays only at 0130-0230 and 1230-1330 on 3824 kc. with educational programs in the Sesotho language.

**Brazil**—A recently opened station is *R. Alvorada*, Londrina, 3345 kc. At present it is operating at 0400-2200, in Portuguese, with classical music and some ads. The power is 1000 watts and reports go to Caixa Postal 414, Londrina.

**Ceylon**—*R. Ceylon*, Colombo, has been found on 11,800 kc. at 0930-0950 with Indian and western music and commercials.

**Chile**—Station CE604, *R. Libertad*, Antofagasta, 6040 kc., features a taped program in Spanish at times which is supplied by *Deutsche Welle* (Germany) and which ends at 1900, followed by an ID and local anmts. Care should be taken not to confuse this station with the Colombian on the same channel, *Deutsche Welle*, or the clandestine *R. Libertad*.

*R. Cooperativa*, Santiago, 9575 kc., has been noted at good level around 2030. The

**ALL SHORT-WAVE REPORTERS!**

Please note that your Short-Wave Editor has acquired a new post office box. From now on, all reports and DX Award applications should go to:

Hank Bennett, Short-Wave Editor
POPULAR ELECTRONICS
P. O. Box 333
Cherry Hill, N.J. 08034

IS is the march from "Pomp And Circumstance."

**China**—*R. Peking* is currently scheduled to N. A. (West Coast) at 2200-2300 and 2300-0000 on 7080, 9457, 9755, and 11,820 kc.; and to the East Coast at 2000-2100 and 2100-2200 on 7035, 9480, 11,945, and 15,095 kc. An xmsn to Europe is broadcast at 1530-1630 on 6210 and 7080 kc. and at 1630-1730 on 6210 and 6270 kc.

**Colombia**—Station HJBG, *La Voz del Norte,* Cucuta, 4875 kc., was noted with a test xmsn from 0300 to 0400 consisting of continuous music of varied types and ID's in Spanish. This station has been inactive but is now being noted irregularly with test xmsns.

**SHORT-WAVE ABBREVIATIONS**

| | |
|---|---|
| anmt—Announcement | N.A.—North America |
| Eng.—English | R.—Radio |
| ID—Identification | s/off—Sign-off |
| IS—Interval signal | s/on—Sign-on |
| kc.—Kilocycles | xmsn—Transmission |
| kw.—Kilowatts | xmtr—Transmitter |

**Cuba**—At deadline time, Havana's schedule read: to Northern Europe in Eng. at 1510-1640 on 15,155 kc.; to Europe in French at 1400-1510 on 15,155 kc.; to N.A. in Eng. at 2200-0100 (French from 2330 to 0000) on 11,865 kc.; to South America in Eng. at 1550-1650 on 15,135 kc. and in Portuguese at 1800-1900 on 15,340 kc.; to the Mediterranean in Arabic at 1530-1610 and in French at 1610-1640 on 17,855 kc.; to the Caribbean in Creole at 2100-2200 on 6060 kc. This schedule is subject to frequent changes.

**Cyprus**—*Bayrak Radio,* a xmtr of the Turkish Cypriot Fighters, operates at 0130 and 1230 in Turkish, at 0200 and 1330 in Greek, and at 0230 and 1400 in Eng., all on 6700 kc. Other xmsns are listed for 0630 in Turkish, 0700 in Eng., and 0730 in Greek in "the 41, 44, and 48 meter bands"; one known frequency is 7275 kc. The latter xmsns may be irregular.

**Dominican Republic**—*La Voz de la Libertad,* Puerto Plata, 6185 kc., is noted at 1700-1800 with ID's and music. This may be a new station; the last reported outlet on this channel was HI9U, *R. Tropical.*

**El Salvador**—Station YSS, *Radiodifusora Nacional,* San Salvador, 9555 and 6010 kc., now has a DX program entitled "Reports of the World" on Sundays at 2045 and Mondays at 2000.

**England**—Here is the complete Eng. schedule for the western hemisphere from London: The General Overseas Service to Canada, U.S.A., and Mexico at 1615-1745 on 17,790 kc., at 1615-1930 on 15,300 kc., at 1800-2145 on 11,780 kc., and at 1900-2145 on 9510 kc.; to the West Indies, Central America, and South America (north of the Amazon, including Peru) at 0600-0615 on 15,410 kc., at 1455-1815 on 17,870 kc., at 1615-1930 on 15,140 kc., at 1745-1930 on 15,070 kc., at 1700-2230 on 11,750 kc., at 1745-2230 on 9580 kc., and at 2045-2230 on 6110 kc.; to South America (south of the Amazon, but excluding Peru) at 1500-1815 on 17,740 kc., at 1500-2230

on 15,260 kc., at 1615-2230 on 12,[illegible]5 and 9510 kc., and at 1800-2230 on 11,750 kc.; to the Falkland Islands (Sundays only) at 1700-1745 on 11,955 and 9765 kc.; to N.A. at 0930-1130 on 15,300 kc. There is also a special Eng. xmsn to the Caribbean area at 1730-1745 on 17,870, 15,140, and 11,750 kc.

**Ethiopia**—Station ETLF, *Radio Voice of the Gospel,* Addis Ababa, has been found on 15,185 kc. with Eng. news at 0935; this xmsn is to India and runs from 0900 to 0955. However, Eng. is only scheduled at 0900-0930 on Mondays and Thursdays, while the 0930-0955 portion is listed as being daily. Other Eng. xmsns: at 0330-0425 to W. Africa on 11,755 kc. (or 11,745 kc. as an alternate); at

**SHORT-WAVE CONTRIBUTORS**

Francis Welch, Jr. *(WPE1CRV)*, Rochdale, Mass.
Joe DiLeo *(WPE1FQV)*, Waterbury, Conn.
Stephen Berlinski *(WPE1FTF)*, Bridgeport, Conn.
Edward Zebrowski *(WPE1FTG)*, Holyoke, Mass.
Bill Smith *(WPE1FZ)*, Uxbridge, Mass.
Irwin Belofsky *(WPE2BYZ)*, Brooklyn, N. Y.
Gerry Klinck *(WPE2FAH)* Buffalo, N. Y.
John Weinstein *(WPE2LHR)*, Deal, N. J.
William Graham *(WPE2LMU)*, Binghamton, N. Y.
Bill Merrill *(WPE2LOM)*, Bronxville, N. Y.
John Wilson *(WPE3NB)*, Wilmington, Del.
Grady Ferguson *(WPE4BC)*, Charlotte, N. C.
John Brunst *(WPE4BQ)*, Neptune Beach, Fla.
Curt Cochran *(WPE4HDV)*, Kingston, Tenn.
Bobby Conder *(WPE4HOT)*, Winston-Salem, N. C.
Jack Keene *(WPE5BMP)*, Houston, Texas
Tim Towery *(WPE5DRA)*, Port Arthur, Texas
Hubert Beavers *(WPE5DWC)*, Albuquerque, N. M.
Walter Home, II *(WPE6DZC,)* San Francisco, Calif.
Dan Schonberg *(WPE8FWH)*, Shaker Heights, Ohio
Glenn Borden *(WPE8HQI)*, Cleveland, Ohio
James Dell *(WPE8HSY)*, Dayton, Ohio
Philip Cutler *(WPE9EFL)*, Barrington, Ill.
Joe Larson *(WPE9EPQ)*, Rothschild, Wis.
John Beaver, Sr. *(WPEØAE)*, Pueblo, Colo.
Jim Martin *(WPEØDJO)*, Minneapolis, Minn.
Jack Perolo *(PY2PE1C)*, Sao Paulo, Brazil
Fred Parsons *(VE3PE1ZI)*, Welland, Ont., Canada
Marshall Rowley *(VE7PE7S)*, Vancouver, B. C., Canada
Grant Cooper *(VP9PE1G)*, Smith's Parish, Bermuda
Jack Alexander, Jr., Huntington Beach, Calif.
George Bennett, Anderson, Ind.
Bernard Greene, Brooklyn, N. Y.
David McBrayer, Hayward, Calif.
Joe Piechuta, Meriden, Conn.
Michael Poore, Washington, D. C.
Albert Sauerbier, Washington, N. J.
Alan Schneider, APO, New York, N. Y.
Station ETLF, Addis Ababa, Ethiopia
*Radio Television Francaise,* Paris, France
*Radio Japan,* Tokyo, Japan
*Sweden Calling DX'ers,* Stockholm, Sweden

1430-1500 to "nearby areas" on 7165 kc.; and at 1400-1425 to S. Africa on 9705 kc.

*R. Addis Ababa* is noted in the Home Service on 5055 kc. with s/on at 2230 in Amharic. After an ID at 2328, the program is in Somali.

**France**—The latest schedule from Paris shows just two Eng. xmsns: at 0245-0300 with French lessons to Spain, Portugal, and England on 7160 kc.; and at 0800-0900 to the Far East on 15,245, 17,765, and 21,620 kc.

**Haiti**—Station 4VEH, Cape Haitien, is on the air at 0530-0630 in Spanish, at 0630-1000 in Eng., and at 1200-1400 in French and Creole; all daily. There are additional broadcasts on Sundays at 1400-1600 in Eng. and at 1800-2030 in French and Creole. The

channels used are 11,835, 9770, 6120, 2450, and 1035 kc.

**Japan**—Nihon Broadcasting Co. operates as follows: Net I on 3925, 6055, and 9595 kc., all with 50 kw.; Net II on 3945 and 7230 kc., with 10 kw. The s/on is at 1530 daily, with both nets operating in dual to 1800, when they split. Back in dual at 0300, they run together until 1100 s/off. Scheduled in Eng.: Net II at 1815 with a Japanese language lesson; all stations at 0545 with a language lesson, and at 0850 with "English Topics."

Tokyo's General Service in Eng. and Japanese is scheduled as follows: at 1900 and 2000 on 15,105, 15,195, and 15,310 kc.; at 2100, 2200, and 2300 on 15,195, 15,285, and 15,310 kc.; at 0100, 0200, 0300, 0400, 0500, and 0600 on 9505, 15195, and 15,310 kc.; at 0700, 0800, 0900, 1000, 1100, 1200, 1300, and 1400 on 9505, 9740, and 11,815 kc.; at 1500 on 6080, 9505, and 9675 kc.; at 1600 and 1700 on 6080, 9675, and 15,105 kc.; and at 1800 on 15,105, 15,195, and 15,310 kc. Xmsns are 30 minutes long.

**Korea (South)**—There is now a DX program from Seoul on the last Thursday of each month at 2215-2230 (Wednesday) and at 0545-0600 on 9640 kc.; at 0245-0300 on 11,925 kc.; and at 0915-0930 on 11,950 kc.

**Lebanon**—Beirut is now scheduled at 1330-1530 to Africa on 15,380 kc. (Eng. at 1330); at 1800-2000 to South America on 11,900 kc.; and at 2030-2300 to N.A. on 9625 kc. (Eng. at 2130). Omnidirectional xmsns are broadcast at 2300-0230 and 1115-1330 on 5980 kc. and at 0430-1100 on 9545 kc.

**Malawi**—Malawi Broadcasting Corp. transmits in Eng., Nyanja, and Tumbuka daily at 2300-0100 and 0500-1500 on 3955 kc. from Mikuyu (formerly Zomba). Reports go to P. O. Box 453, Blantyre, Malawi.

**Netherlands Antilles**—Station PJA6, *R. Victoria*, Aruba, is reportedly operating once again on 905 kc. This station had moved to 900 kc. after being widely reported evenings in N.A. on 905 kc. The move back to 905 kc. is unconfirmed but well worth checking. English may be heard at 1745-1915.

**New Caledonia**—*R. Noumea*, 7170 kc., is noted along the West Coast from 0230 to 0320 with pop music, commercials, French news, and an excellent signal.

**Paraguay**—Station ZPA11, *R. Charitas*, Asuncion, has returned to the air on 6112 kc. with varied programming, in Spanish. It is heard best from about 1900 to 2000 and, at times, as early as 1700.

## DX States Awards Presented

*To be eligible for one of the DX States Awards designed for WPE Monitor Certificate holders, you must have verified stations (any frequency or service) in 20, 30, 40, or 50 different states in the U. S. The following DX'ers have qualified for and received the 20 States Verified Award.*

### *Twenty States Verified*

Tim Vorel (WPE9FIB), Westchester, Ill.
Joseph Sabo (WPE7BTZ), Seattle, Wash.
Michael R. Fletcher (WPE4DPS), Waco, Texas
Jack Dardes (WPE3EGL), Titusville, Pa.
Robert Coleman (WPE4FXO), Atlanta, Ga.
Beverly Davis (WPE1EVL), Dalton, Mass.
Jack Palladay (WPE9EOE), Indianapolis, Ind.
Daniel Miller (WPE4DAG), Covington, Ky.
Robert Weisz (WPE2IKF), Huntington Station, N.Y.
Richard Armstrong (WPE9EHW), Jacksonville, Ill.
John Geery (WPE2ESZ), Rochester, N. Y.
Leonard Thomas, Jr. (WPEØAZD), St. Louis, Mo.
Tor Kovacs (WPE9GTJ), Jacksonville, Ill.
Bruce Creighton (WPE5DFX), New Orleans, La.
Carl Luckett (WPEØDVN), Overland, Mo.
Bill Tomkiewicz, Jr. (WPE2FZJ), Elizabeth, N. J.
Kenneth Butler (WPE8GDX), Elkins, W. Va.
John McDonald (WPEØAQE), Kansas City, Mo.
Robert Lindsey (WPE8FCM), Marietta, Ohio
John Long (WPE3DYU), Lebanon, Pa.
William Ruland (WPE2HHU), Mattituck, N. Y.
Edward Semrad (WPE9GTP), Milwaukee, Wis.
Barry Bauer (WPE8FUO), Cleveland, Ohio
John Draut (WPE2JVI), New York, N. Y.
Joseph Mead (WPE2CNQ), North Arlington, N. J.
George Molnar, Jr. (WPE2KHZ), Buffalo, N. Y.
Richard Desharnais (WPE1FGI), Dracut, Mass.
Robert Wilson (WPE2LMM), Flushing, N. Y.
Dennis Kitchin (WPE3EKQ), King of Prussia, Pa.
Ronald Hebard (WPE5DMR), Tulsa, Okla.
Gregg Calkin (VE1PE3L), St. John, N. B., Canada
Walter Pyne (WPE3ETH), Hagerstown, Md.
Thomas Kuckertz (WPE9EID), Chicago, Ill.
Ronald Koch (WPE9GJS), Skokie, Ill.
Mike Betz (WPE8GDY), Marion, Ohio
Michael Vanek (WPE2KFA), Binghamton, N. Y.
Junior Dean (WPE5DEI), Amory, Miss.
Mike Mallory (WPE9FJC), Granite City, Ill.
Edward Peters (VE4PE4X), Winnipeg, Man., Canada
Robert Jackson (WPE4HCF), Maysville, Ky.
Fred Eichler (WPE2IWF), Douglaston, N. Y.
Eugene Bond, Jr. (WPE2JHW), Moorestown, N. J.
William Lee (WPE3FGU), Bethlehem, Pa.
Ronald Valastin (WPE2KTJ), New Hyde Park, N. Y.
Charles Dobbins, Jr. (WPE8BEV), Detroit, Mich.
David Garvey, Sr. (WPE8GVB), Grand Rapids, Mich.
Richard Farrell (WPE4HLL), Clearwater, Fla.
John Schnell (WPE9GLS), West Bend, Wis.
Hector Otero (WPE9DTB), Oak Park, Ill.
Jim Schroeder (WPEØDYP), Waverly, Iowa
A. A. Jinkinson (VE3PE1WO), Toronto, Ont., Canada
Roger Franz (WPEØDZE), Omaha, Nebr.
Robert Crowell (WPE4HKO), Fort Walton Beach, Fla.
Hieronim Ziarkowski (WPE2KQY), Holmes, N. Y.
Brian Rogers (WPE8ARB), Allen Park, Mich.
Edward Mohrman (WPE9FRF), Chicago, Ill.
Donald Lee (WPE3EYB), Lebanon, Pa.
Stuart Hecht (WPE4HKV), Jacksonville, Fla.
Jimmy Turnbull (VE2PE1GS), Town of Mount Royal, Que., Canada
Bobby Scott (WPE4HHX), Kingsport, Tenn.
Lloyd Gosa (WPE4FYP), Americus, Ga.
Richard Moore (WPE3CGR), Wilmington, Del.
Joan Van Boven (WPE8HNC), Kalamazoo, Mich.
Bruce Scott (WPE2HYD), Orchard Park, N. Y.
Gerry Klinck (WPE2FAH), Buffalo, N. Y.
Roger Leclerc (VE3PE1RY), Chalk River, Ont., Canada
Richard Hansen (WPE6FJO), Santa Clara, Calif.
Wayne Zessin (WPE9FTW), Chicago, Ill.

**Peru**—Station OAX80, *R. Amazonas,* Iquitos, is heard on 9770 kc. from 2045 to 2110 with music and from 2230 with "Musica Bailables," in Spanish. Station OAX8V, *R. Eco,* Iquitos, has returned to the air on 5010 kc. after an absence of some months; best reception is generally from 2230 to 2330, when Spanish vocals and language are heard.

**Poland**—Warsaw has Eng. to Africa at 0700-0730 and 0800-0830 on 7125, 11,840, and 15,120 kc.; at 1400-1430 on 9525 and 9540 kc.;

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## Beacon Stations

This is a continuation of the list of beacon stations that was started last month. With careful tuning and patience, you may be able to log a number of these stations. For the most part, they are low-powered and do not operate continuously. They identify in slow-speed Morse code by call-sign. Unless otherwise noted, the stations listed this month, by frequency in kilocycles, are located in Colombia, S. A. More next month.

| | |
|---|---|
| **1602** | LGM, Leguizano, 1000 watts |
| **1608** | EPO, El Paso, 1000 watts |
| **1610** | CTG, Cartagena |
| **1618** | LMM, Los Mochis, 1200 watts |
| **1620** | EBG, El Bagre, 400 watts |
| **1625** | CDT, Condoto, 50 watts |
| **1650** | CLO, Cali |
| **1655** | CUC, Cucuta, 750 watts |
| **1665** | CIO, Cicuco, 250 watts |
| **1670** | CZU, Corozal, 400 watts |
| **1685** | DRC, Dos Rios, 1000 watts |
| **1690** | MDE, Medellin, 1000 watts |
| **1705** | AFI, Amalfi, 400 watts |
| **1710** | BUN, Buenaventura, 1000 watts |
| | IQQ, Iquique, Chile, 100 watts |
| **1745** | CGW, Cartago, 1000 watts |

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and at 1700-1730 on 7125, 9525, 9760, 11,840, and 15,120 kc.

**Senegal**—*R. Senegal* verified a report on 764 kc. with a folder which stated that the 764-kc. outlet was rated at 200 kw. Operations were listed at 0300-1300 on 9720, 5960, and 1538 kc. and at "other hours" (not specified) on 9720, 4950, 4890, 1538, and 764 kc. The 9720-kc. outlet is heard in French with U.S. pop tunes from 1840; a newscast in French is given at 1854, and s/off is at 1858.

**Vatican City**—*Vatican Radio,* 9705 kc., was noted at 2000 s/off giving a list of frequencies; 9705 kc. was not listed.

**Vietnam**—The *Voice of Vietnam,* in its newest program schedule, lists Eng. at 2000-2100, 2345-0000, 0500-0530, 0830-0900, 1030-1100, and 0600-0630, all on 11,840 and 9840 kc.

**Yemen**—This country is reported to be constructing a 5000-watt station which will transmit in Eng. and French in the 41-meter band. No other details are available.

**International Waters**—*R. Atlanta,* aboard the motor ship "Mi Amigo," is located off Frinton-On-Sea, England, and operates on 1493 kc. at 0000-1400. Reports go to 47 Dean St., London W 1. —30—

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| 44 | Wiley & Sons, Inc., John | 110 |

**CLASSIFIED ADVERTISING 118, 119, 120, 121, 122**


### Tune In on Air Traffic

(*Continued from page* 59)

ing of 40° or northeast). Once you get the hang of it, it's easy to understand.

When a pilot asks for an *altimeter reading*, he means that he wants the current barometric pressure at the airport so he can set his altimeter for that pressure. As air pressure varies with the weather, it changes the reading of an altimeter, which depends on outside air pressure for its operation. The control tower will respond with the current barometric pressure at the airport (such as 29.95—meaning 29.95 inches of mercury in a mercurial barometer). When the pilot sets his altimeter according to this pressure reading on the ground, the instrument will give a direct reading, on its altitude scale, of his height above sea level.

**More Information.** If you get one of the navigation charts used by the pilots, your enjoyment of your aircraft receiver will be increased even more. On the chart, you will see airports and designations for all the radio facilities and navaids used by pilots as well as familiar landmarks which are often referred to by the pilots in giving their position reports.

These maps are called "sectional charts" and can be obtained for 30 cents each from your local airport office or from the U. S. Coast and Geodetic Survey in Washington, D. C. At first glance, they seem complicated, but all the map symbols are clearly explained on the back of each chart. After you've obtained one for your area and studied it carefully, you'll have a much greater appreciation of the work done by pilots, and a better understanding of all the things you hear on your aircraft receiver.

For a complete city-by-city listing of the major airport tower and navaid frequencies, see the November, 1962, issue of POPULAR ELECTRONICS, pages 42-43. If you would like to build your own airport eavesdropper, you'll find construction details for a comparatively simple but sensitive "VHF Listener" in the March, 1964, issue. —30—

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## FOR SALE

**FREE!** Giant bargain catalog on transistors, diodes, rectifiers, components. Poly Paks, P.O. Box 942, Lynnfield, Mass.

**GOVERNMENT** Surplus Receivers, Transmitters, Snooperscopes, Parabolic Reflectors, Picture Catalog 10¢. Meshna, Nahant, Mass.

14 Weather Instrument Plans $1.00. Saco, Box 2513B, South Bend, Indiana.

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**DIAGRAMS** for repairing Radios $1.00. Television $2.50. Give make model. Diagram Service, Box 1151 PE, Manchester, Connecticut 06042.

**ROCKETS:** Ideal for miniature transmitter tests. New illustrated catalog, 25¢. Single and multistage kits, cones, engines, launchers, trackers, technical information, etc. Fast service. Estes Industries, Penrose 18, Colorado.

**CB WPE QSL** Cards, Samples Free. Radio Press, Box 24, Pittstown, New Jersey.

**"SPECIAL!** WPE-SWL-CB-QSL cards, 3 colors, $2.50 per 100—Free Samples, Garth, Jutland, New Jersey."

**TRANSISTORIZED** Products Importers catalog, $1.00, Intercontinental, CPO 1717, Tokyo, Japan.

**CANADIANS—GIANT** Surplus Bargain Packed Catalogs. Electronics, Hi-Fi, Shortwave, Amateur, Citizens Radio. Rush $1.00 (Refunded). ETCO, Dept Z., Box 741, Montreal, **CANADA.**

**SENSITIVE,** Reliable Switches for Alarms, Remote Control, Temperature, etc. DODSON'S, 206 E. Main, Post, Texas.

**WPE-CB-QSL** cards—Brownie-W3CJI—3111A Lehigh, Allentown, Pa. 18103. Catalogue with samples 25¢.

**INVESTIGATORS,** free brochure, latest subminiature electronic surveillance equipment. Ace Electronics, 11500-L NW 7th Ave., Miami 50, Fla.

**BUY** direct from the manufacturer and save! Test instruments, cabinets, radios. Free catalog. Tattershall Manufacturing Co., Hamilton, Mo.

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**CONVERT** any television to sensitive, big-screen oscilloscope. Only minor changes required. No electronic experience necessary. Illustrated plans, $2.00. Relco Industries, Box 10563, Houston 18, Texas.

**IGNITION!** Transistor. Coil, ballast $7.95. Free Parts Lists. Transfire, Carlisle 40, Mass.

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**PRINTED CIRCUIT BOARDS.** Hams, Experimenters. Catalog 10¢. P/M Electronics, Box 6288, Seattle, Wash. 98188.

**MEN ONLY**—Surprise Package $1.00. Enterprises, Box 266-D. Spring Valley, New York 10977.

**FREE** Catalog, Electronic Parts Bargains. Franklin Electronics, Box 51a, Brentwood, N.Y. 11717.

**TV CAMERAS,** transmitters, converters, etc. Lowest factory prices. Catalog 10¢. Vanguard, 190-48 99th Ave., Hollis, N.Y. 11423.

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**SUPERSENSITIVE** Transistor treasure, coin detectors. Kits, assembled models. $19.95 up. Free catalog. Relco-A33, Box 10563, Houston 18, Texas.

**CALL**-Sign Decals. Gold 3x1¼" Individual Characters. Your Amateur, CB, Or SWL Call-sign—$1.00. Nordlund, 7635 West Irving Park, Chicago, Ill. 60634.

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**COLOR TV.** Convert your black and white TV to color. Completely Electronic. No Mechanical Gadgets. Costs about $35. Construction Details $4.75. Don Britton Enterprises, 7906 Santa Monica Blvd., Hollywood 46, Calif.

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**SIMPLEX** transistor system described February Popular Electronics. Complete kit quality components, $15.00 Postpaid. Electromart, 1616 South 81st St., Milwaukee, Wisconsin 53214.

**CB-WPE-QSL'S.** Humorous—Regular, Catalogue—samples 25¢ (refundable). KCJ-1955, Lile Guill, Rustburg, Va.

**ELECTRIC** Fun 200 experiments $1.00. Exciting, Educational. Cutziff, 7 Valley View Road, Orinda, Calif. 94563.

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**QSL'S.** Christmas designs and regulars. Catalogue-samples 10¢. Longbrook, Box 393-Y, Quakertown, N.J.

**CAMERA,** Transistorized Products, others, Catalogue $1.00. Gitai Shibamuro No. 10, Sendamachi, Koto-Ku, Tokyo, Japan.

**PLASTIC** Sign—Your Ham, CB call. For automobile, shack. $1.00. Pugh's, E. 12523 16th, Spokane, Wash. 99216.

**INVISIBLE** beam transistorized burglar alarm. Complete Plans—$2.00. Beck, 777 Ruth Drive, Newbury Park, Calif.

**TV CAMERA** under $40.00—Completely transistorized space age flying spot scanner—Schematics, Photographs, Plans—$3.00. Transistorized shocking cane—simple complete schematic—Plans—$1.00. Beck, 777 Ruth Drive, Newbury Park, Calif.

**TELEPHONE** Voice Switch: (LS-500). Actuates automatically and unattended any tape or wire recorder. Pictorial installation instructions included. $23.75. Post Paid USA, WJS Electronics, 1525 No. Hudson, Hollywood, Calif. 90028.

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**QSL-CB-SWL** Cards Printed. Samples 10¢. Martin, 828-B1 Schuylkill Avenue, Reading, Pa. 19601.

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**WHOLESALE** electronic parts and equipment. Free catalog. Western Components, P.O. Box 2581, El Cajon, Calif.

**CANADIANS FIRST GRADE** transistors and components. Free catalogue includes reference data on over 200 transistors. J. & J. Electronics, Box 1437, Winnipeg, Manitoba.

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## WANTED

**CASH** Paid! Unused tubes, electronic equipment. Barry, 512 Broadway, N.Y.C. 12.

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**TUBE** Headquarters of the World! Free Catalog (tubes, electronic equipment) write! Barry, 512 Broadway, N.Y.C. 12.

**BRAND** New Tubes. World's lowest prices on Radio, TV—industrial—special purpose tubes. Write for free parts catalog. United Radio, Newark, N.J.

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**RADIO & T.V.** Tubes—33¢ each. Send for free list. Cornell, 4213 University, San Diego, California 92105.

## ELECTRONICS

**HEAR** Aircraft, Tower Emergencies, weather. Portable 9 Transistor AM-FM-VHF Aircraft receiver. Beautiful Black with Gold Trim. $26.50. Free Details. Transco, Box 13482, North County Station, St. Louis 38, Mo.

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## PATENTS

**INVENTIONS;** Ideas developed for Cash/Royalty sales. Raymond Lee, 2104G Bush Building, New York City 36.

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